Geophysical Abstracts 142 July-September 1950

(Numbers 12126–12339)

By MARY C. RABBITT *and* S. T. VESSELOWSKY

GEOLOGICAL SURVEY BULLETIN 976-C

Abstracts of world literature contained in periodicals, books, and patents

DEPARTMENT OF THE INTERIOR
March 3, 1849

UNITED STATES GOVERNMENT PRINTING OFFICE WASHINGTON : 1950

UNITED STATES DEPARTMENT OF THE INTERIOR

Oscar L. Chapman, *Secretary*

GEOLOGICAL SURVEY

W. E. Wrather, *Director*

For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price 25 cents (paper cover). The printing of this publication has been approved by the Director of the Bureau of the Budget, February 1948.

CONTENTS

Page

Introduction 141

Earth physics 143

- Gravity 143
- Magnetism 151
- Seismology 156
- Electricity 167
- Radioactivity 168
- Heat 171
- Volcanology 172
- Tectonophysics 172
- Internal constitution 177

Exploration geophysics 177

- General 177
- Gravimetric methods 179
- Magnetic methods 180
- Seismic methods 182
- Electrical methods 185
- Radioactive methods 188
- Well logging 189
- Technical aids 191

Patents 192

- Gravity methods 192
- Magnetic methods 192
- Seismic methods 193
- Electrical methods 194
- Radioactive methods 194
- Well logging 197
- Technical aids 200

Index 207

GEOPHYSICAL ABSTRACTS 142, JULY-SEPTEMBER 1950

By Mary C. Rabbitt and S. T. Vesselowsky

INTRODUCTION

Geophysical Abstracts are prepared by the Geophysics Branch of the Geological Survey, United States Department of the Interior, as an aid to those engaged in geophysical research and exploration. Periodicals, books, and patents are regularly searched for material dealing with geophysical exploration and with basic earth physics as represented by the fields of gravity, magnetism, electricity, seismology, radioactivity, and heat.

Abstracts in this issue have been grouped in three sections dealing with earth physics, exploration geophysics, and patents. The first section has been further divided into sections on gravity, magnetism, seismology, electricity, radioactivity, heat, volcanology, tectonophysics, and the internal constitution of the earth. The section on exploration geophysics covers gravimetric, magnetic, seismic, electric, and radioactive methods, well logging, and technical aids. Within each group the order of the abstracts is as follows: general papers, bibliographies, and reviews; theory; instruments; methods and techniques; observations.

As many readers may not have ready access to the source material, an effort is made to include all significant new material in these abstracts. Where geographic names quoted differ from the decisions of the United States Board on Geographical Names, the latter are added in brackets.

Geophysical Abstracts 1–86 and 112–127 were issued as Information Circulars by the Bureau of Mines, and 87–111 were issued as Bulletins of the Geological Survey. Beginning with 128, Geophysical Abstracts are published as Bulletins of the Geological Survey.

All Geophysical Abstracts published as Information Circulars are now out of print. Geophysical Abstracts issued as Bulletins of the Geological Survey (except Nos. 87 and 88 which are out of print) may be purchased as single copies or by subscription from the Superintendent of Documents, Government Printing Office, Washington 25, D. C. For subscription, the Superintendent will accept a deposit of $5 in payment for subsequent issues. When this fund is near depletion, the subscriber will be notified. The deposit may also be used to purchase any other publication from the Superintendent of Documents.

Acknowledgements.—Special thanks are due James R. Balsley, Jr., Roland G. Henderson, H. R. Joesting, Elizabeth King, and Isidore Zietz who have prepared the abstracts signed J. R. B., R. G. H., H. R. J. E. K., and I. Z.

EARTH PHYSICS

GRAVITY

12126. Morelli, Carlo. Il geoide e la geofisica [The geoid and geophysics]: Annali Geofis., v. 2, no. 2, pp. 251–254, 1949.

One of the most important results obtainable from the calculations connected with the tying of different geodetic networks is the possibility, at least theoretical, of determining the exact shape of the geoid and its deviation from the reference ellipsoid. This also gives some indication of the structure of the crust and the distribution of heavy masses in its upper layers. When such calculations are made for regions of irregular topography and complicated tectonics, however, the results sometimes appear paradoxical because of different reductions applied in the process of calculations. Furthermore, the assumed dimensions and the orientation of the reference ellipsoid influence the numerical values obtained for the deviations of the geoid from the reference ellipsoid. In view of possible future geophysical applications it is more advantageous to use especially in mountainous countries one geoid of large dimensions instead of several partial ones, as one for Italy, another for France, and so on.

This, of course, does not affect the purely geodetic importance of an unique ellipsoid of great dimensions, a problem which is of great interest in studies of the undulations of the geoid.—*S. T. V.*

12127. Kazanskii, I. A., The present state and the prospects of gravimetric studies of the earth in Russian]: T͡Sentral'nyi nauchno-issledov. Inst. geodezii, aeros"emki i kartografii, Trudy, no. 51, pp. 3–45, 1948.

Many problems of geophysicis can be solved only on the basis of data gathered from surveys covering the whole surface of the earth. Therefore the regional investigations of different countries ought to be coordinated in a common scheme as to their aims and methods employed. The status of gravimetric investigations of different countries is reviewed criitcally on the basis of information which, in many instances, seems to be obsolete. In the opinion of the author, the U. S. S. R. is the most advanced country as to the methods used. In its western part, the distances between the stations, with few exceptions, are 33 km., a density of one station per 1,000 sq. km. The next best gravimetric network is that of the United States, Alaska excluded, where the density of the stations is one per 6,000 sq. km. The rest of the Western Hemisphere has a rather sparse gravimetric network.

The United States is characterized by great variation of the station density in different parts of the country, and the existence of many separate areas surveyed in great detail by private concerns, primarily petroleum companies, which do not publish the findings of their investigations. Among other gravimetric networks mentioned are the networks of India, Asia, Africa, countries of the British Commonwealth, Switzerland, Belgium, Germany, Italy, North Africa, and part of China and the Philippine Islands.

Gravitational investigations made over water from on board a ship or on ice floats, such as the measurements of Russian scientists made near the North Pole, are mentioned separately. Surveys by Vening Meinesz in Dutch East Indies gave material for far-reaching scientific conclusions. Marine surveys in the U. S. S. R. during 1930–35 led to the discovery of the continuation of the Crimean ridge westward beneath the bottom of the Black Sea and established gravitational features connecting the Ural Mountains with the Donbass hills beneath the Caspian Sea.

To make a gravimetric survey which embraces the whole surface of the globe a success, it is necessary to prepare in advance a common program, to make decisions as to the instruments used, their precision, corrections to be applied, types of the reductions of readings, checking of the data, cataloging of the results in form of tables or maps. The findings of such surveys must be adapted for future needs in purely scientific works, in geology, general geodesy, geophysics, as well as in industrial exploration. The general survey must be preceded by establishment of a basic network of absolute gravitational measurements. This network must be referred not to one central station, such as Potsdam, but to an adjusted average of the determinations of several observatories such as Teddington, Washington, Potsdam, Pulkovo, and others. The types of instruments to be used and their accuracy are also discussed.—*S. T. V.*

12128. Boaga, Giovanni. Sugli errori medi delle deviazioni della verticale [Average errors in determinations of the deviation of the vertical]: Geofis. Pura e Appl., v. 16, fasc. 1–2, pp. 13–15, 1950.

A suggestion has been made that the deviation of the plumb line determined by the methods of spherical astronomy be used as an indicator of underground disturbing bodies in gravimetric surveys. Analysis of the errors which would affect such determinations indicates that in certain unfavorable cases the errors can be as much as 10°, making questionable the practical value of such determinations.—*S. T. V.*

12129. Kazanskii, I. A. Considerations on the establishment of an adjusted value of absolute gravity to be used in the universal gravimetric survey [in Russian]: T͡Sentral'nyi nauchno-issledov. Inst. geodezii, aeros''emki i kartografii, Trudy, no. 51, pp. 61–82, 1948.

Determination of the absolute value of gravity and the derivation of a standard formula for the variation of this force over the surface of the earth is one of the fundamental problems of gravimetry, important in studies concerning the shape of the earth, and as a quantity related to other basic physical constants. The Potsdam value of gravity became the internationally accepted constant in 1909, but for the last 10 years the correctness of this value has been repeatedly questioned.

The Potsdam determinations are analyzed metrologically, and the details of measurements and the applied corrections discussed. Using a different treatment of the experimental data of Kuhuen and Furtwangler, *g* in Potsdam is found to be 981.259±0.011 gal, rather than 981.274±0.003 gal.

A detailed analysis is made also of the gravity determinations by P. R. Heyl and G. S. Cook in Washington, by J. S. Clarke in Teddington, and by H. L. Dryden in Washington. Finally, a tying of the Potsdam, Washington, and Teddington data is attempted and a table is given of the most probable gravity values for these three points derived from all four measurements. The results are considered as tentative only.—*S. T. V.*

12130. Lozano Calvo, Luis. Determinación de una formula para la gravedad normal a partir del elipsoide terrestre de Struve, adecuada especialmente para España [The derivation of a formula for standard gravity, corresponding to Struve's terrestrial ellipsoid, with special reference to Spain]: Rev. Geofís., v. 9, no. 33, pp. 1–41, 1950.

The equation of gravity force best fitted to the Spanish gravimetric network is determined. From numerous reference ellipsoids Struve's was chosen because it was the basis of the Spanish geodetic network. As the first step in the calculations, the cartesian system of coordinates was replaced by elliptical ones and the Laplace potential equation was transformed to new coordinates. The energy of the centrifugal force of the terrestrial rotation was added to the value of the potential function obtained. The potential function thus obtained and the terrestrial ellipsoid chosen must satisfy the following conditions: the ellipsoid is an ellipsoid of revolution, its exterior surface must be an equipotential surface, and the mass enclosed must be equal to the total mass of the earth as determined by astronomical considerations. As the fourth determining condition, the sum of differences between the theoretically computed gravity force at any point and that observed in Spain must be a minimum. The summation is not extended over the whole surface of the earth but limited to Spain and the 208 Spanish gravitational stations. For every one of these the values of the standard gravity force and of the corresponding anomaly were computed.

Similar computations were repeated using the formulas of Helmert (1901 and 1915), Bowie, Cassinis, and Heiskanen. The use of Struve reference ellipsoid results in the least total sum. The results of the determinations based on Struve reference ellipsoid are presented on maps, showing the Fayé and Bouguer isoanomalies, and the curves of differences between the values of these anomalies. A table contains gravity values for points of Spanish territory as function of their geographic latitude.—*S. T. V.*

12131. Cunietti, Mariano. Collegamento gravimetrico delle stazioni di Padova, Bologna e Milano per mezzo di gravimetro Western G–4A [The gravimetric tying of the stations Padova, Bologna, and Milan using the Western G–4A gravimeter]: Riv. Geofis. Appl., v. 11, no. 1, pp. 27–36, 1950.

During February 1950, a gravimetric tie was made between the Milan and Bologna stations and at the same time the tying of the Bologna-Padova stations was repeated. The instrument used was the Western G–4A gravimeter with a constant of 0.0768. As the range of the instrument is only 90 mgal., the total gravimetric profile was divided into several smaller steps. The difference Δg between Milan and Padova was determined as 86.490 mgal. Several intermediate stations were selected so that pendulum and gravimetric determinations made previously could be compared, and in most of the intermediate stations the agreement between the Δg values determined by different geophysicists was found to be very satisfactory. Because certain discrepancies were also established, the author warns that the latest values, obtained by gravimeters, should not always be assumed as the best. Even if the gravimeters are very accurate, the determination of their constants necessitates a precision of calibration which is very difficult, if not impossible, to attain.—*S. T. V.*

12132. Gloden, Albert. Comparaison théorique de deux stations gravimétriques voisines [Theoretical comparison of two neighboring gravimetric stations]: Soc. Naturalistes Luxembourgeois, v. 42, pp. 6–9, 1948.

A gravimetric survey of the Grand-Duché de Luxembourg was made in October 1948 in which 96 stations were occupied with Paris as the base station. Gravity at Luxembourg-Athenée, central station for the country, was found to be 980.980 gals, with a probable error of ±0.1 mgal. German gravity determinations during the occupation of Luxembourg included a determination of g=980.9772 gal (referred to Potsdam system) with an error of less than ±0.65 mgal. for a point B near the Athenée station.

Using the Cassinis formula for the variation of gravity with latitude, and applying free air and Bouguer corrections with assumed ground density of 2.5, g for the point B of the German network was computed to be 980.977102 gal. in the Paris system, a difference of only 0.098 mgal. (*See* Geophys. Abstract 11690.)—*S. T. V.*

12133. Kilchling, Karl. Zur Eötvösschen Drehwaage [The Eötvös torsion balance]: Naturf. Gesell. Freiburg im Breisgau, Ber., Band 39, pp. 225–233, 1949.

The general theory of the operation of Eötvös torsion balance is discussed and modifications of the design employing two, three, four, and six masses, differently suspended, which make it adaptable for measuring the horizontal gradient of gravity, are analyzed.—*S. T. V.*

12134. Kilchling, Karl. Über neue Drehwaagenformen für Schweremessungen [New types of torsion balance for gravity measurements]: Gerlands Beitr. Geophysik, Band 61, Heft 2, pp. 79–85, 1950.

The general differential equation describing the operation of the torsion balance is derived under the assumption that the forces of gravity acting within the volume of the instrument on its various members are not proportional to the distances of built-in masses from the centroid of the movable system.

In this equation the third derivatives of the gravitational potential appear. By an appropriate selection of the number, size, and disposition of the masses it is possible to make the coefficients of the second and third derivatives equal either to zero or to very great values as compared with other coefficients of the equation. Therefore it is possible to design forms of the moving system of the balance that are especially adapted for direct measurement of the horizontal gradient or of the curvature.—*S. T. V.*

12135. Kilchling, Karl. Über eine Drehwage zur/Messung von U_{zzx} und U_{zzy} [A torsion balance measuring U_{zzx} and U_{zzy}]: Gerlands Beitr. Geophysik, Band 61, Heft 3, pp. 181–183, 1950.

In a previous publication (*See* Geophys. Abstract 12134) a generalized equation of the torsion balance was derived and a mechanical system determined for measuring the second and the third derivatives of the potential function U. In the present study the special case in which the coefficients of all derivatives, with the exception of U_{zzx} and U_{zzy}, are zero, is analyzed. Such a system can be employed for obtaining in three azimuthal positions of the balance three equations containing the last two derivatives and the unknown constant of the instruments. From the system of these three equations all the unknown values can be easily computed. The necessary sensitivity of the balance is also calculated and seem to be equal to that of good instruments in present use.—*S. T. V.*

12136. Grushinskii, N. P. The use of gravimeters for the measurements at stations of the first and second order [in Russian]: Sbornik nauchno-tekhnicheskikh i proizvodstvennykh statei, no. 23, pp. 16–21, 1949.

During the summer of 1948 a gravity station of the first class was established in Kiev, Ukraine, by tying this station with two base stations at Moscow and Poltava. The instruments used in the measurements were two Molodenskii gravimeters, type PG–0, two similar gravimeters type GKM–5, and four Nørgaard gravimeters. All instruments were carefully calibrated, and gravimeters having steel springs were tested for the effect of the vertical component of the earth's magnetic field. For transportation special airplanes were used. The ties between the airports in Moscow and Poltava and the local observatories were made by separate measurements, again using gravimeters.

The article contains logs of the observations, detailed calculations applying corrections for drift of the instruments, barometric and temperature variations. The gravity value at Kiev was finally determined as 981072.3±0.78 mgal.—*S. T. V.*

12137. Frolov, A. I. The effect of the vertical temperature gradient on the determination of gravity by pendulum measurements [in Russian]: Sbornik nauchno-tekhnicheskikh i proizvodstvennykh statei, no. 16, pp. 9–22, 1948.

For several years errors in gravitational measurements have been noticed at stations where determinations were made during winter months, especially in the northern regions of the U. S. S. R. As the explanation of these errors the supposition was advanced that temperature variation takes place along the length of the pendulum causing variation of its length. Numerous measurements made under corresponding conditions as well as with artificially increased temperature differences in the room where the instruments were installed indicated the temperature difference between the extremities of a pendulum often may be as high as 1° C. Under unfavorable conditions, the errors in the gravity measurements may be as much as 5–8 mgal. It was empirically established also that the temperature variation along the rod of the pendulum can be represented by a parabolic equation.

By measuring the temperature at extremities and assuming the parabolic variation of the temperature, it is possible to compute the change in the length of the pendulum and to apply the necessary corrections in the determinations of g.—*S. T. V.*

12138. Frolov, A. I. The dynamic temperature coefficient of pendulums [in Russian]: Sbornik nauchno-tekhnicheskikh i proizvodstvennykh statei po geodezii, kartografii, aeros''emke i gravimetrii, no. 22, pp. 35–38, 1949.

On the basis of observations of pendulum apparatus during gravity surveys in northern Siberia, it is concluded that established temperature stratification in a room or in the housing of a pendulum takes considerable time to disappear, even with external thermal conditions remaining constant. If the external temperature rises, the thermal gradient generally increases; if the external temperature decreases, the thermal gradient also may decrease where ventilation is good, but quite often becomes even greater. Therefore, the dynamic temperature coefficient cannot be computed and applied to bronze or brass pendulum instruments on the basis of readings of the external temperature. It is also impossible to compute the exact value of the dynamic temperature coefficient from measurements of temperature on different levels in the housing, although this is an improvement. It is necessary to design a thermometer indicating the integrated temperature difference over the whole length of pendulum and this thermometer should have a thermal inertia equal to that of the pendulum.—*S. T. V.*

12139. Grushinskii, N. P. The dynamic temperature effect of a gravimeter [in Russian]: T͡Sentral'nyi nauchno-issledov. Inst. geodezii, aeros"emki i kartografii, Trudy, no. 51, pp. 117–134, 1948.

The most important factor limiting the accuracy of modern gravimeters is the variation of its temperature. To attain an accuracy of 0.1 mgal. it is necessary to keep the temperature of the instrument constant within 0.01° C. and in some constructions 0.001° C. It is also essential to have the same temperature in all parts of the gravimeter, a condition which can be fulfilled only after hours of waiting before readings are taken. As long as different parts do not have the same temperature, the geometric configuration of the system is modified, and, by this dynamic temperature effect, readings of the instrument are changed.

The effect is analyzed and the necessary corrections are computed. Variation of the housing caused by the change in temperature is assumed as negligible. The most sensitive member of the system is the horizontal level, and the spring system, usually made of elinvar, is much less affected. The equalization of the temperature among various parts of the gravimeter is assumed as taking place through the exchange of heat from any element of the metallic surface to the air and vice versa in the corresponding colder parts. From these assumptions, the effect of variations of temperature on the indication of the instrument is computed, if the variation of the elasticity of the spring with temperature is known as well as the changes in the configuration of the system by thermal expansion.

The computed temperature changes of different parts were checked experimentally and the agreement between these values was found satisfactory. Readings of the instrument at the same station were also repeated at various temperatures, applying the computed corrections, and were found to be satisfactorily constant. Certain suggestions as to the design of the springs, of the thermometer and of the level are made with view of improving the operation of the instrument. It is believed that with the suggested changes in construction the precision of the gravimeter can be improved to ±0.5 mgal. without the use of a thermostat, and this can be of practical importance in surveying regions of difficult accessibility.—*S. T. V.*

12140. Schleusener, Alfred. Grundlagen der grosregionalen Gravimetermessungen für das Amt für Bodenforschung [Principles of the extended regional gravitational survey of the Amt für Bodenforschung]: Geol. Jahrb. 1943–1948, Band 64, pp. 187–199, 1950.

A regional gravimetric survey of Germany was begun in 1934 for the purpose of aiding in industrial explorations for useful minerals by giving accurate local gravity data and at the same time forming a foundation for theoretical studies of geodetic, geologic, and geophysical problems. By the end of 1945, about 40,000 stations had been measured. Distances between stations in the gravitational network ranged from 10 to 25 km. The gravimetric data were referred to the standard Potsdam system, with g=981.274 gal. This figure was later proved to be too high by 13 mgal. Different reductions to be applied to measured values are discussed in detail, especially the Bouguer reduction containing the often disputed density value. The question of choosing the best adapted reference level is also discussed.—*S. T. V.*

12141. Bollo, Robert, and Gougenheim, André. Au sujet de la variation périodique de la gravité [On the periodic variation of gravity]: Annales Géophys., tome 6, no. 2, pp. 133–135, 1950.

The total amplitude of the variation of gravity is the sum of two terms: the first, the result of the movement of the earth in its orbit and of changes in the position of the earth in relation to the sun and moon; the second, produced by the elastic deformation of the earth by forces causing the change of the earth's gravitational field. The ratio of the first component to the second is approximately 1.15 or 1.30.

On the basis of determinations made hourly at five French observatories the total amplitude was found to be 0.20–0.25 mgal. Thus the amplitude caused by the deformation of the earth is only 0.03–0.07 mgal., a quantity which is difficult to measure accurately. Microseismic disturbances often interfere with these measurements. An important feature of the wave curve representing these variations of gravity is the absence of phase displacement in the second term, pointing to a very small energy dissipation during the deformation of the earth.—*S. T. V.*

12142. Castro, Honorato de. Variaciones de la pesanter [Variations of gravity]: Asociación Mexicana de Geologos Petroleros Bol., v. 1, no. 2, pp. 163–178, 1949.

During the two weeks May 10–24, 1949, simultaneous determinations of gravity were made every 15 minutes at several selected points of the earth's surface, including three stations in Mexico, to study the deformations of the figure of the earth caused by the attraction of the moon and sun. In the present article equations are derived for the influence of these bodies on the force of gravity at a point on the earth's surface. Discrepancies between the computed and the measured values are caused by changes in the shape of the earth.—*S. T. V.*

12143. Eblé, Louis. Sur les variations de la verticale [On the variations of the vertical]: Annales Géophys., tome 6, no. 2, pp. 128–129, 1950.

From records of more than 6 years, two periods of the variation of the vertical were discovered: one equal to a lunar month, 29.5 solar days, the other equal to one-half this interval. The north-south component of the variation shows both these periods, with the semi-monthly amplitude twice the monthly one. The east-west component shows only the semi-monthly variation. This and other less pronounced peaks of the wave curve cannot be satisfactorily explained by celestial mechanics.—*S. T. V.*

12144. Skeels, D. C. Geophysical data on the North Carolina Coastal Plain: Geophysics, v. 15, no. 3, pp. 409–425, 1950.

Geophysical exploration conducted during 1944–46 by the Esso Standard Oil Co. on the Coastal Plain of northeastern North Carolina and southeastern Virginia included regional gravity, magnetic, and seismic refraction surveys, and a detailed seismic reflection survey in the Pamlico Sound area.

The gravity and magnetic maps indicate a basement of complex composition with a north-south grain, similar to that exposed in the Piedmont of North Carolina and Virginia. Most of the gravimetric and magnetic features are believed to be related to variations in the density and magnetic properties of the pre-Cretaceous basement, rather than to basement topography.

Refraction data show a high-velocity layer with an eastward regional dip. In the western part of the area this layer is identified as the crystalline basement, whereas in the eastern part it is believed to be a limestone in the lower Cretaceous series. Reflection seismic data likewise show eastward regional dip, a number of noses plunging east and northeast, and some possible faults, but no closed structures.—*H. R. J.*

12145. Carreño, Alfonso de la O. Cartas de anomalias de la gravedad en la Republica Mexicana [Maps of gravity anomalies in Mexico]: Ing. hidraulica en México, v. 3, no. 4, pp. 23–35, 1949.

On the basis of data from 168 pendulum stations and 52 gravimeter stations two maps of Mexico have been drawn, one representing the Bowie anomalies, and the other Bouguer anomalies. Tacubaya Observatory (g=978.941 gal) was used as base, and the value of gravity correlated with the U. S. Coast and Geodetic Survey base station in the Commerce Department building, Washington, D. C.—*S. T. V.*

12146. Bödvarsson, Gunnar. Um bergmyndanir undis basaltinu [On mountain making and basalt] [In Icelandic with English summary]: Tímarit verkfraeðing afélags íslands gefið út af stjórn félagsins, 34 árg., 2 hefti, pp. 11–14, 1949.

Bouguer anomalies of 7 to 19 mgal. were found along a profile between Akureyri and Grímsstadhir in northern Iceland, where values of about 30 mgal. were expected for isostatic equilibrium. As similar anomalies and excess gravity are found near Reykjavík and in Scotland, the Hebrides, Orkney Islands, and Shetland Islands, these anomalies may be regional. Small free air anomalies in Iceland suggest that the basement there consists of light continental rocks. Presence of numerous hot springs indicate an abnormal temperature gradient, to some extent caused by a high level of basaltic magma in the crust. As this magma has a greater density than normal continental rocks, the basement probably includes a thick series of light sediments. Compaction and flow of these sediments may have caused many of the faults in the basalt plateau. Accumulation of probably 10,000 feet of basalt during a relatively short time has caused a temperature rise in the rocks below, and as a consequence part of the crystalline crust has remelted and expanded 5 to 10 percent. This expansion may have contributed to the great number of dikes and fissures.—*M. C. R.*

12147. Bollo, Robert and Goguel, Jean. Mesures gravimétriques en Bretagne [Gravity measurements in Brittany]: Bur. Recherches géol. et géophys. Pub. 8, 37 pp., 1950.

A gravimetric survey was made of Brittany during June 1949 with 262 stations occupied, many of them several times. The instrument used was a North American gravimeter. The accuracy of the determinations is estimated as 0.05 mgal., necessitating application of the correction for the lunar and solar effects.

The results of the measurements and of the computations are presented in a table and a map. For every station the table gives the geographic coordinates, the altitude, computed value of normal gravity, measured value of gravity, and the Bouguer anomaly calculated with density assumed as 2.7. Bouguer anomalies are also shown on a map on the scale 1:600,000.

For the whole region, the average value of the Bouguer anomaly is +0.45 mgal. If Brittany is considered as a rigid block exercising uniform pressure on its base, the excess of measured gravity over that computed by the international formula, is the same order of magnitude as the effect of the far zones. Brittany may thus be considered as fully compensated.—*S. T. V.*

12148. Ku, K. G., Ceng, Youngtsen, and Chang, C. Y. Isostatic anomalies of 208 Chinese gravity stations: Chinese Geophys. Soc. Jour., v. 1, no. 2, pp. 101–139, 1949.

The results of the computations of isostatic reduction for 208 gravity stations in an area of about 750,000 sq. km. of China are presented. Gravity determinations used in the study were made by different observers between 1934 and 1939 using two Holwek-Lejay gravimeters.

Reduction tables used in computations were those of the U. S. Coast and Geodetic Survey, Heiskanen, and Vening Meinesz. Several topographic maps of the country were used as the basis of the reduction. The best and the most dependable for near topography from zone *Z* to as far as zone *K*, were the 1:50,000 maps prepared by the Chinese General Staff Land Survey. The contouring of these maps has been done at 20-meter intervals, fairly satisfactory for elevation readings. The Hayford-Bowie scheme of computation, as later modified by E. C. Bullard, and those of Heiskanen and Vening Meinesz were used, and three types of isostatic anomalies have been worked out. Results of the computations are presented in a table, giving for every station its geographic position, altitude, gravity value, and computed isostatic anomalies.—*S. T. V.*

MAGNETISM

12149. Benfield, A. E. The earth's magnetism: Sci. Am., v. 182, no. 6, pp. 20–24, 1950.

A review and discussion of theories of the origin of terrestrial magnetism, including those of Blackett and of Bullard and Elsasser.—*M. C. R.*

12050. Bullard, E. C. Terrestrial magnetism: Physics Today, v. 2, no. 9, pp. 6–13, 1949.

A review of theories of the origin of terrestrial magnetism.—*S. T. V.*

12151. Bullard, E. C. Electromagnetic induction in a rotating sphere: Royal Soc. London Proc., ser. A, v. 199, no. 1059, pp. 413–443, 1949.

A discussion is given of the induction of electric currents in a rotating conducting sphere surrounded by a stationary conducting shell. Although the primary purpose was to obtain results applicable to problems in terrestrial magnetism, the analytical developments cover a wider field.

Formal solutions for the magnetic field *H*, the electric field *E*, and the current density *I* satisfying the Maxwell field equations for a moving medium are tabulated according as the fields are toroidal or poloidal and according to the behavior of the solution at the origin. The process of solution subject to boundary conditions is illustrated for a sphere rotating in an insulating medium and in a uniform magnetic field. The results are extended to a rotating sphere surrounded by a conducting concentric shell and it is found that the external magnetic field is uninfluenced by the presence of the shell. Induction by stationary and rotating central multipoles as well as induction with current sources are treated. Important formulas are given from which the electromagnetic couples tending to stop the rotating sphere can be computed for various cases discussed.

The results obtained for induction in an oscillating sphere suggest that the magnetic effects of tidal motion in the earth's core will be small. The case of freely decaying fields that occur when there is no externally maintained field is discussed in terms of the normal modes. The methods of this paper can be employed to treat problems in which currents are induced in a rotating sphere in a varying field. Other extensions of the analysis are indicated.—*R. G. H.*

12152. Cagniard, Louis. Sur les phenomènes d'induction électromagnetique dans une sphère conductrice. Applications geophysique [On the phenomena of electromagnetic induction in a conductive sphere. Geophysical applications]: Univ. Toulouse, Fac. Sci. Annales, tome 8–1944, pp. 59–89, 1947.

Theoretical investigations of the magnetic field of the earth indicate that about 94 percent of its intensity is caused by internal phenomena such as electric currents traversing the core. It has also been proved that once such currents have been started, their extinction will be extremely slow. Thus, if in a very ancient epoch in its history the earth, moving through the celestial space, ran into an expanse occupied with magnetic fields, currents would be induced in the core of the earth which is endowed with high electric conductivity. These currents would continue for billions of years if the decrease of the angular momentum of the rotating earth did not cause their relatively rapid damping. As long as the currents continue, they produce magnetic phenomena identical with the known geomagnetic field.

The author starts from Maxwell's basic equations of electrodynamics and by extended mathematical computations arrives at these conclusions, but he considers them to be tentative because too many unknown variables make verification of these conclusions impossible at the present time.—*S. T. V.*

12153. Alfvén, Hannes. Discussion of the origin of the terrestrial and solar magnetic fields: Tellus, v. 2, no. 2, pp. 74–82, 1950.

Recent work has shown that a magnetic field can be greatly amplified by hydrodynamic motions. For example, the strong magnetic fields of sun spots may be explained by assuming that motions in the interior of the sun have amplified the rather weak general solar field, and in interstellar space an originally weak field can be amplified by hydrodynamic motion. By analogy, terrestrial and solar magnetic fields may be explained in terms of some sort of magneto-hydrodynamic process.

The dynamics of the field amplification and the generation of magnetic fields in celestial bodies are discussed with special reference to the earth's magnetic field. The core of the earth is considered to be the place where the magnetic field is generated. Starting from a meridional field of simple structure, the hydrodynamic motions may drag out the lines of force and effect a breeding of new lines of force directly, or the motions may at first give the field a tangential component which corresponds to a twisting of the lines of force. When this exceeds the meridional component new lines of force are bred and the meridional field amplified. In order to maintain the general field at a certain strength, the hydrodynamic motion must be supplied continuously with energy. As an alternative to Elsasser and Bullard's idea that this source of energy is in nuclear reactions, the possibility is suggested that the energy is supplied by nonuniform rotation.—*S. T. V.* and *M. C. R.*

12154. Wulf, O. R., and Hodge, M. W. On the relation between variations of the earth's magnetic field and variations of the large-scale atmospheric circulation: Jour. Geophys. Research, v. 55, no. 1, pp. 1–21, 1950.

According to the dynamo theory of the diurnal variation of the earth's magnetic field, all large-scale atmospheric motions in the electrically conducting region should in some measure affect the field and appear in magnetic records. Many of the conspicuous and even violent changes from day to day in the magnetic records of a single observatory may thus be a direct reflection of correspondingly marked changes in the atmospheric circulation, and conductivity, in the upper atmosphere over the observatory. A set of magnetic records may thus give a direct indication of upper-atmospheric wind patterns. A comparison of certain prominent features of geomagnetic data with the character of the large-scale atmospheric circulation as shown by observations in the lower atmosphere provides considerable evidence for some interrelationship. A detailed study of this relationship should lead to an explanation of certain conspicuous features of the geomagnetic variations in terms of the atmospheric circulation, and also to a deduction of certain large-scale features of the atmospheric circulation from current magnetic observations.—*I. Z.*

12155. Runcorn, S. K., Benson, A. C., and Moore, A. F. The experimental determination of the geomagnetic radial variation: Philos. Mag., v. 41, no. 319, pp. 783–791, 1950.

Distributed theories attribute the origin of the dipole component of the earth's main magnetic field to a fundamental property of rotating matter; core theories ascribe it to current systems within the core. Runcorn and Chapman have shown that for core theory the horizontal intensity increases with depth below the surface of the earth while for distributed theory it decreases. Measurements of this component in mines should make it possible to decide between the two theories. Preliminary measurements in mines in South Africa and in Lancashire in England have already been reported. The results of more extensive measurements made in three mines in England are reported in this paper. The removal of anomalous gradients is discussed in detail. The experimental results agree favorably with those predicted for core theory and do not support a distributed theory.—*R. G. H.*

12156. Maple, E., Bowen, W. A., and Singer, S. F. Measurement of the earth's magnetic field at high altitudes at White Sands, N. Mex.: Jour. Geophys. Research, v. 55, no. 1, pp. 115–126, 1950.

Experimental verification of the existence and nature of current sheets in the upper atmosphere was attempted by firing an aerobee rocket, housing a total field magnetometer, to a height of 368,000 feet and telemetering the data to ground stations. The launching occurred at White Sands because of existing facilities there. Because the instrumental error was large in comparison to the expected magnetic field of the current sheets, no positive detection of the "discontinuity" could be made. A description of the method and instrument, a diagram of the instrument layout, and graphs of altitude against time and decrease in field against time are presented. The latter curve compares favorably with that of the theoretical field produced by a dipole at the earth's center. The authors suggest that the use of the magnetometer to determine missile orientation, in conjunction with a photo-orienter located in the missile, might prove valuable in cosmic-ray studies. It is concluded that at a more favorable location, for example, the equator, detection of the magnetic field "discontinuity" of current sheets is feasible.—*I. Z.*

12157. Howe, H. H. The *u*-measure of magnetic activity. Jour. Geophys. Research, v. 55, no. 2, pp. 153–157, 1950.

The author compares the *u* measure of magnetic activity with other measures such as *C*, *K*, and *h* for each month of 1929–30. There are high correlations among *h*, *C*, and *K* but almost no correlation between any one of them and *u*. An analysis of the data is given and the numerical values of the various measures of geomagnetic activity as well as their correlation coefficients are presented in tabular form. It is concluded that the *u* measure is not suited for its intended purpose; that it measures chiefly changes in the level of activity rather than the level of activity itself.—*I. Z.*

12158. Bartels, Julius. Remarks on Dr. Howe's paper: Jour. Geophys. Research, v. 55, no. 2, pp. 158–160, 1950.

The author agrees with the basic conclusion of Dr. Howe's paper "The *u*-measure of magnetic activity," namely, that *u* measures changes in the level of magnetic activity rather than the level of activity itself. However, the advantages of *u* as a measure for post perturbation are upheld and a comparison is made between *u* and *K* indices. It is recommended that tables similar to those by Vestine be constructed for post perturbation.—*I. Z.*

12159. Poisson, Charles. Le magnétisme terrestre à Madagascar [Terrestrial magnetism in Madagascar]: Acad. Malgache Mem., fasc. 37, 83 pp., 1949.

A collection of observations and measurements of geomagnetic elements made at different places of Madagascar from 1884 to the present.—*S. T. V.*

12160. Grenet, Gaston. Variomètre électromagnétique pour l'enregistrement des variations rapides du champ magnétique terrestre [Electromagnetic variometer for recording rapid variations of the geomagnetic field]: Annales Géophys., tome 5, no. 3, pp. 188–195, 1949.

A moving magnet placed inside a coil, if exposed to variations of geomagnetic field, induces in the coil electromotive force of an intensity sufficient to act on a galvanometer. The magnet and the galvometer thus form two coupled oscillating systems. The motion of the galvanometer may be represented by a differential equation of the fourth order. Analysis of this equation makes it possible to establish the principal characteristics of the instrument.

An appropriate selection of the shape of the magnet makes it possible to determine the influence of the geometric dimensions of the instrument on its operation, especially when the length of the magnet is great compared to its cross section. This increases the sensitivity of the instrument.

A theoretical analysis of the operation of the instrument is presented and the optimum design is determined. The apparatus has some similarity to the electromagnetic seismograph of the author (*See* Geophys. Abstract 11244).—*S. T. V.*

12161. Castet, J. Variométre électromagnétique type A [Electromagnetic variometer of the A-type]: Annales Géophys., v. 5, no. 3, pp. 214–215, 1949.

An electromagnetic variometer designed in accordance with principles developed by G. Grenet (*See* Geophys. Abstract 12160) and constructed during the field work in the Sahara using available expedient parts is described. The sensitivity of the instrument is as high as 10^{-6} gauss per millimeter of the scale which is more than necessary for the good recording of geomagnetic disturbances. The galvanometer used is a standard Leeds and Northrop instrument.—*S. T. V.*

12162. Dupouy, G. Perturbation du champ magnétique terrestre et des courants telluriques par les chemins de fer électrifiés [Disturbances of the geomagnetic field and of telluric currents by electric railways]: Annales Géophys. tome 6, no. 1, pp. 18–50, 1950.

Studies in conjunction with the French National Railways have demonstrated that disturbances on the magnetic records of the Chambon-la-Forêt Observatory may be related to traffic on the Paris-Orleans line, 28 km. away. Disturbances are greatest when the current is interrupted, as much as 5 gammas or 15 millivolts per km. Horizontal stratification in the region permits calculations in advance of magnetic disturbances resulting from a single parameter characterizing the currents along the electrified line. Calculation of telluric disturbances requires in addition knowledge of the variation of resistivity with depth. Agreement between observed and calculated values is satisfactory.—*M. C. R.*

12163. Roche, Alexandre. Anomalies magnétiques accompagnant les massifs de pépérites de la Limagne d'Auvergne [Magnetic anomalies associated with peperino massifs in Limagne, Auvergne]: Acad. Sci. Paris Comptes Rendus, tome 230, no. 18, pp. 1603–1604, 1950.

Geomagnetic measurements were made over peperino deposits in six different regions of Auvergne. In all of them negative magnetic anomalies were found, ranging from about 100 gammas where basalt is absent, to several thousand gammas where basalt dikes are present. Negative anomalies observed over these eruptive masses are attributed to remanent magnetism, opposite to the present geomagnetic field. As peperino deposits are a source of structural material, these negative anomalies may serve as good indicators in prospecting.—*S. T. V.*

12164. Weber, E. K., Gassmann, Fritz, Niggli, Ernst, and Rothersberger, Hans. Die magnetische anomalie westlich von Locarno [The magnetic anomaly west of Locarno]: Schweizer. min. pet. Mitt., Band 29, Heft 2, pp. 492–509, 1949.

An important magnetic anomaly west of Locarno, Switzerland, was discovered in 1921. A detailed magnetic survey of an area of about 100 sq. km. was made in 1944–45, with 178 stations occupied. At most of the stations both the horizontal and the vertical components of the geomagnetic vector were determined, using La Cour's QHM magnetometer and Schmidt's vertical magnetic balance. The instruments were carefully calibrated, their daily drift determined and the influence of temperature observed. The error in the measurements of the horizontal component is estimated as ±20γ, that of the vertical ±5γ. The magnitude of the established anomalies is of the order of 5,000γ. The results of the survey are presented in a table and in two maps. A geological study aimed to aid interpretation of the results of the survey is planned.—*S. T. V.*

SEISMOLOGY

12165. Rothé, Jean. Seismes et volcans [Earthquakes and volcanoes]: 135 pp., Paris, Presses Universitaires de France, 1948.

A semipopular account in the Que Sais-je series. The subjects discussed are: macroseismic studies; seismic waves; seismicity of the earth; causes of earthquakes; and volcanoes.—*M. C. R.*

12166. Green, A. E., and Zerna, W. Theory of elasticity in general coordinates: Philos. Mag., v. 41, no. 314, pp. 313–337, 1950.

The authors seek to simplify the presentation of the theory of elasticity for finite displacements in general coordinates, through use of the tensor calculus. Three coordinate systems are used: a cartesian system for locating the points of body B_0 at rest at time $t=0$; a cartesian system for the points of the body in the strained state B at time t, and a curvilinear coordinate system which moves continuously with the body as the original state B_0 passes to state B at time t. The invariance of line elements under transformation is used to derive the components g_{ij}, g^{ij} and G_{ij}, G^{ij} of metric tensors from Euclidean spaces defined by B_0 and B, respectively. The fundamental equations of the theory of elasticity are then expressed in terms of quantities involving these tensor components.

Since the strained and unstrained bodies are situated in Euclidean space, the components of the Riemann-Christoffel tensors ${}_0R_{ijkl}$ for B_0 and R_{ijkl} for B vanish, yielding the compatibility equations. The equations of motion are presented in different forms, the most compact being that involving the covariant derivative of the components of the stress tensor. The principle of virtual work is used to establish the necessary and sufficient conditions for equilibrium. The strain energy functions are derived for the isothermal and adiabatic cases.

The authors believe the treatment is straightforward and that the methods used and the relations obtained contain many new features.—*R. G. H.*

12167. Brekhovskikh, L. M. Reflection of plane waves from stratified media [in Russian]: Zhurnal teknich. fiziki, v. 19, no. 10, pp. 1126–1135, 1949.

The problem of the reflection of plane waves is treated for any angle of incidence of the incoming wave and for all physical properties of the reflecting layer. For electromagnetic waves this is the dielectric constant, varying with the depth of the penetration of the wave, and for elastic waves, the controlling parameters are the density of medium and the acoustic velocity, both as functions of the depth of penetration of the wave into the reflecting medium.

The solution of the problem is obtained directly by determining the ratio of the amplitudes of the reflected and the incoming waves. These waves are mathematically described in complex form; their ratio gives the coefficient of reflection for the moduli and for the phase angles.

Starting with Maxwell's equations for electromagnetic waves, the equations of the incoming and the reflected waves are derived for the case when the vector of the electric field is perpendicular to the plane of incidence.

Similarly the differential wave equations for acoustic waves are written for the continuum and the expressions of the wave velocities derived for a similar angle of incidence. By forming the ratio of the amplitudes, the coefficient of reflection is obtained in the form of a differential equation of the first order. The solution of the last equation is found by Picard's method and by the procedure suggested by Försterling. The solution is obtained in the form of an infinite convergent series.

The results are applied to the special case of normal incidence for which the exact solution is known. Comparing this with the consecutive approximations of the series for differently varying characteristics of the boundary layer, the author finds differences of not more than one percent.—*S. T. V.*

12168. Brekhovskikh, L. M. Reflection and refraction of spherical waves [in Russian]: Uspekhi fizich. Nauk, v. 38, no. 1, pp. 1–42, 1949.

The method of treating the problem consists in resolution of spherical waves into plane waves, the theory of which has been previously discussed (*See* Geophys. Abstract 12167). The electrical vector of electromagnetic waves is assumed to lie in the plane of incidence, so that the electromagnetic field is fully described by Hertz's vector perpendicular to the boundary plane. For acoustic waves, the analogous physical property is the acoustic potential. A vertical dipole was assumed as the source of electromagnetic waves and a pulsating small sphere the source of acoustic waves. In resolving the spherical waves, the spherical wave can be represented as a double integral of plane waves differently oriented in space. Integration is carried out over a complex plane. Among the plane waves it is necessary to introduce also those with varying amplitudes (inhomogeneous waves), because the superposition of ordinary waves cannot satisfy the boundary conditions that the Hertzian vector equal zero at the zero point of the coordinates. The resolution of the spherical wave into a combination of plane ones can be done in many ways, and the selection of the most appropriate is made in view of the easiest way of evaluating the double integral representing this wave. This integration is also determined by the physical properties of the medium and can be simplified in special cases, such as when the boundary is perfectly reflecting, an approximation which can be often made.

Into the formula for the reflected wave enters also the term representing the boundary wave, identical with Mintrop's wave in seismic phenomena.

A detailed analysis of the solution is given, indicating possibilities of obtaining approximate solutions in certain cases. Experiments in which reflection and refraction of spherical waves can be observed and measured are also described.—*S. T. V.*

12169. Dix, C. H. Pulse propagation in two spatial dimensions: Geophysics, v. 15, no. 3, pp. 447–455, 1950.

The physical picture of plane and spherical wave propagation cannot be readily applied to cylindrical waves because the latter cannot be propagated without change of form. The problem of propagation when the principal radii of curvature of the pulse front surface are not the same is investigated in the simple case of an elastic compressional cylindrical pulse confined between two concentric circular cylinders. The appropriate differential equation is solved by a method of Riemann, and the solution expressed in terms of the resolvent kernel of a Volterra integral equation of the second kind. It is concluded that for any initially limited axially symmetric disturbance, if energy is transmitted outwards it is necessarily transmitted inwards. The discussion applies to any wave motion satisfying the cylindrical wave equation.—*R. G. H.*

12170. Press, Frank, and Ewing, Maurice. Propagation of explosive sound in a liquid layer overlying a semi-infinite elastic solid: Geophysics, v. 15, no. 3, pp. 426–445, 1950.

The Pekeris theory of normal-mode sound propagation from an impulsive point source located in the first of two liquid layers is extended to include the case of a liquid layer overlying a semi-infinite elastic solid. The mathematical theory is developed for both a harmonically varying point source and an arbitrary initial time-varying disturbance at the source. Phase and group velocity curves, as well as dispersion curves in the first and second normal modes, are presented for conditions approximating basaltic, granitic, and sedimentary bottoms.

It is found that for solid bottoms, large amplitude waves appear only after the arrival of the first shear waves; and that there is an arrival of a train of very low frequency waves travelling with the speed of Rayleigh waves in the bottom, the waves increasing in frequency and amplitude with increasing time. For both liquid- and solid-bottom theory, a high-frequency wave travelling with the speed of sound in water arrives riding on a low-frequency rider wave; the water waves and the rider waves merge to form a train of waves of large amplitude that is known as the Airy phase. The frequency of the latter is determined by the depth of water and the elastic structure of the bottom. The ideal location of geophones and hydrophones is discussed in the light of the theory.—*R. G. H.*

12171. Thomson, W. T. Transmission of elastic waves through a stratified solid medium: Jour. Applied Physics, v. 21, no. 2, pp. 89–93, 1950.

The transmission of a plane elastic wave at oblique incidence through any number of parallel solid layers of different material and thickness is studied theoretically. The equations for displacements and stresses in a medium are used together with the continuity of particle velocities and normal and shear stresses at the interfaces to derive an expression for quantities in the nth layer in terms of quantities in the first layer. Matrices are used to systematize the analysis and facilitate computations. The results are used to determine the reflection and transmission coefficients in several special cases.—*R. G. H.*

12172. Sezawa, Katsutada, and Kanai, Kiyoshi. On the propagation of Rayleigh waves in dispersive elastic media: Tokyo Imp. Univ. Earthquake Research Inst., Bull., v. 19, pt. 4, pp. 549–553, 1941.

Studies of the propagation of dispersive Rayleigh waves (*See* Geophys. Abstract 5795) are extended to the case of a homogeneous, nonstratified medium, characterized by the presence of a reactive force which is proportional to the displacement of the point. Differential equations of wave motion are derived and expressions given for the velocities of different waves. These equations show that Rayleigh waves in a semi-infinite medium of the assumed properties will be dispersive. It is concluded also that in certain elastic media the velocity of propagation of Rayleigh waves will increase with the wave length.—*S. T. V.*

12173. Valle, P. E. Effetti dell' attrito interno sulla propagazione delle onde di Love [Influence of internal friction on the propagation of Love waves]: Annali Geofis., v. 3, no. 1, pp. 47-57, 1950.

The effect of internal friction, causing loss of energy on the propagation of Love waves is studied for a medium consisting of a homogeneous layer over infinite semispace. By forming the expressions of mechanical stresses for frictional losses in the medium and assuming identical velocities of the propagation in the upper layer and in the supporting semispace, it can be shown that stratification alone produces a normal dispersion of the wave, and energy losses cause anomalous dispersion. This anomalous dispersion is, however, not very pronounced when the period of the wave is great. The damping coefficient increases rapidly with frequency. If the thickness of the upper layer and the frequency of the wave are not high, the damping is approximately proportional to the thickness and inversely proportional to the square of the period. If the thickness or the frequency is high the damping becomes the function of the period of the wave alone. Computed values are in agreement with those derived from observations.—*S. T. V.*

12174. Valle, P. E. Sulla misura della velocità di gruppo delle onde sismiche superficiali [Determination of the group velocity of surface waves]: Annali Geofis., v. 2, no. 3, pp. 370–376, 1950.

The theory of the measurement of the group velocity in the spectrum of unidimensional surface waves is developed and a formula is given for its calculation. Proof is also presented of the impossibility of determining the velocity of a specific phase in this spectrum from the observations of the incoming waves at two stations.—*S. T. V.*

12175. Antsyferov, M. S. The secondary resonances of a seismograph with spring suspension [in Russian]: Akad. Nauk SSSR Izv., Ser. geog. i geofiz., v. 14, no. 4, pp. 317–333, 1950.

The critical frequencies of a seismograph are computed with special attention to higher harmonics. The supporting spring of the instrument is assumed to have continuously distributed mass.

Starting from the known solution of the vibratory motion of such a spring, the movement of the extremity carrying the inertia mass is analyzed in detail and the conditions of the invariability of the magnification factor of the instrument are discussed.

Critical frequencies of five component harmonics besides the fundamental frequency are determined, and simpler formulas for their approximate computation are derived. The errors of these approximations are also evaluated. Such frequencies as those when the ends of the spring system vibrate in phase with equal amplitudes and therefore with no displacement in relation to one another are also discussed.

Finally, curves are constructed for several seismographs representing the amplitudes of their vibrations as functions of frequencies of disturbing impulses, and these curves compared with those obtained experimentally.

Certain recommendations concerning the construction of the instruments such as the configuration of the springs, means of an effective damping of critical amplitudes, are included.—*S. T. V.*

12176. Sezawa, Katsutada, and Kanai, Kiyoshi. On the initial movement of a seismograph subjected to an arbitrary earthquake motion, solved with operational calculus, pt. 2: Tokyo Imp. Univ. Earthquake Research Inst. Bull., v. 19, no. 3, pp. 443–457, 1941.

Previous studies (*See* Geophys. Abstract 6805) are extended to more complicated shapes of ground movement, such as linear and parabolic displacements as well as simpler cases of repeated movement, which lead to free and forced oscillations.

Model experiments conducted on a vibrating table, which received a sudden jerk of sinusoidal character are described. The observed movement of the pendulum was in agreement with the theoretical results. Certain discrepancies are attributed to the fact that conditions of the experiment do not fully reproduce the assumptions of theoretical analysis. The resulting movement of the pendulum was always in the sense opposite to that of the ground motion.

The Laplacian transformation was applied in mathematical treatment of the problem. The resulting pendulum motion is determined by corresponding integrals in the complex plane. By evaluating these integrals and assuming different degrees of damping in the system, the corresponding greatest displacements of the pendulum were obtained.—*S. T. V.*

12177. Oliphant, C. W. Comparison of field and laboratory measurements of seismic velocities in sedimentary rock: Geol. Soc. America Bull., v. 61, no. 7, pp. 759–788, 1950.

Field measurements of velocities were made in Osage County, Okla., using a single three-component seismometer successively positioned at different horizontal or vertical distances from the shot point. Cores from relevant parts of the section were later studied in the laboratory and their resonant frequencies for forced vibrations in longitudinal and torsional modes determined. The effects of water content, pressure, and temperature as well as measurement frequency and amplitude were also determined so that conditions of laboratory-velocity measurements could be corrected to those of the rock in place. Velocities of $V_P=9{,}200\pm300$ ft./sec. and $V_S=5{,}000\pm200$ ft./sec. were measured in an upper layer of Permian sand and shale approximately 250 feet thick, and $V_P=14{,}000\pm400$ ft./sec. and $V_S=9{,}900\pm300$ ft./sec. in a lower, inhomogeneous layer of limestone. After correcting to the most probable conditions of water content, pressure, and temperature for the rock in place, 17 core specimens from 8 closely spaced horizons in the limestone gave the following bimodal distribution of laboratory velocities: $12{,}600<V_P<14{,}500$ ft./sec.; $8{,}100<V_S<8{,}600$ ft./sec.; $18{,}400<V_P<20{,}400$ ft./sec.; $9{,}500<V_S<10{,}100$ ft./sec.

The following conclusions are drawn: *SV* waves can be generated by a small dynamite blast in sedimentary rocks if the shot hole is shallow and high confining pressures are avoided; *SV* velocity can be determined with approximately the same accuracy as *P* but the transmission path is subject to greater uncertainties; water content is the most important independent variable affecting velocities in near-surface Permian limestones; the Neva limestone may be subdivided on the basis of density and laboratory velocities into two types of alternating microlayers; and under conditions of this work, elastic parameters and Poisson's ratio computed from field measurements differ significantly from those determined by laboratory measurements.—*M. C. R.*

12178. Coulomb, Jean, and Molard, Pierre. Ondes séismiques au fond de la mer des Antilles [Seismic waves over the bottom of the Caribbean Sea]: Annales Géophys., tome 5, no. 3, pp. 212–214, and tome 6, no. 1, p. 65, 1950.

Attention is called to a phase with average period of 0.49 sec. in the coda of certain earthquake records at the Morne des Cadets seismological station. For 16 earthquakes, at epicentral distances of 1,000 to 2,750 km., the average velocity of these waves across the Caribbean Sea was 1,854 m./sec., somewhat higher than the velocity of sound in water. It is suggested that this is a transverse wave propagated through the bottom of the Caribbean Sea. The waves are apparently the same as the *T* waves described by Linehan.—*S. T. V.*

12179. Martin, Jean, and Joset, Alain. Anisotropie de la vitesse des ondes seismiques dans les glaciers due Groenland [Anisotrophy of the velocity of seismic waves in the glaciers of Greenland]: Annales Géophys., tome 5, no. 4, pp. 331–332, 1949.

Measurements of the velocity of seismic waves made in one of the glaciers of Greenland during the French Polar expedition in 1949 indicated a considerable difference in different directions. The maximum velocity of about 3,600 m./sec. was found in the direction of the descending movement of the glacier while the lowest velocity of about 3,200 m./sec. was perpendicular to it. Deep cracks parallel to the direction of greatest velocity, or mechanical anisotropy caused by inequality of the compression, may have produced this anisotropy of ice.—*S. T. V.*

12180. Giorgi, Maurizio. Sui periodi della fase massima di terremoti lontani [Periods of the maximum phase in distant earthquakes]: Annali Geofis., v. 1, no. 1, pp. 116–125, 1948.

Principal characteristics of the strongest seismic waves are considered, with special attention to the question of their periods, as registered during earthquakes of great epicentral distances. An explanation is suggested of the fact that the periods of these remote waves, as for instance of the W_{11} waves, approach 16 seconds.

Data on those waves, taken from the records of early 1946, are presented. They confirm the results obtained by several seismologists who are studying this question.

As an important feature of the waves arriving at Rome Observatory, the fact is mentioned that with the same epicentral distance the periods of the waves arriving from the east are greater than those coming from the Western Hemisphere crossing the Atlantic Ocean.—*S. T. V.*

12181. Menis, S., and Morelli, Carlo. Contributo allo studio della cosidetta "fase principale" di un sismogramma [Contribution to the study of the so-called "principal phase" of a seismogram]: Annali Geofis., v. 2, no. 4, pp. 545–575, 1949.

Investigation of the physical nature of the waves forming the so-called principal phase of a seismogram led to the conclusion that they consist of Love waves and do not include waves predicted by Rayleigh's theory. To see if the Rayleigh waves are perhaps secondary components in the wave spectrum, the seismograms of the earthquake in Japan of November 18, 1941, and that in Peru, August 21, 1942, were analyzed for their component waves by Vercelli's method. Again only Love waves, or surface waves normal to the principal plane and having a vertical component, were found. The existence of such waves was predicted by the theory of Somigliana. The elliptical trajectories of these oscillations and the observed rotation of their axes may be caused by a phase difference between the component waves and the change of the phase angle by reflections and refractions along the path of the waves caused by surfaces of discontinuity in the upper layers of the earth's crust.—*S. T. V.*

12182. Aliverti, Giuseppina, and Solaini, Luigi. Sulla velocità di propagazione delle onde sismiche su brevi percorsi superficiali [The velocity of propagation of seismic waves over short distances]: Riv. Geofis. Appl., v. 11, no. 1, pp. 3–13, 1950.

Records of several bomb explosions at distances ranging from a few kilometers to more than 24 km. recorded on the Pavia Geophysical Observatory seismographs during the war showed extremely low velocities of propagation of longitudinal and transverse waves. A seismic investigation was made over a profile about 1,600 meters long in the vicinity of the observatory. The aim of the observations was to measure the interval of time necessary for the arrival of seismic waves, to determine the velocity of propagation of these waves and their path, to determine the depth of penetration and to study the sharpness of the seismograms. Western Geophysical Company geophones with a natural frequency of 8 c. p. s. and the damping coefficient of 0.61 were placed at an average distance of 100 meters apart and the depth of the shot holes was 2 meters. A velocity of 0.55 km./sec. was found in a surface layer which had a thickness of only 4 meters, presumably equal to the depth of the water table. Two deeper layers had velocities of 1.58 and 1.65 km./sec. The velocity in the second layer was tentatively computed increasing according to the equation $v=1580+0.73\,z$ m./sec., z being the depth in meters.

The depth of penetration of the seismic waves was estimated as 150 meters. The thickness of the upper very low velocity layer may vary with the seasons of the year, depending on the precipitation of the preceding weeks.—*S. T. V.*

12183. Lehmann, Inge. On two explosions in Danish waters in the autumn of 1946: Geofis. Pura e Appl., v. 12, pp. 145–161, 1948.

Explosions in ammunition sunk into the sea off the Danish coast were recorded at the København, Lund, and Göttingen observatories. Records of two such explosions are described in detail and compared with that of an earthquake.—*M. C. R.*

12184. Bartels, Julius. Wissenschaftliche Ergebnisse der geophysikalischen Beobachtungen der Sprengung auf Helgoland [Scientific findings from the geophysical observations of the Helgoland explosion]: Geol. Jahrb. 1943–48, Band 64, pp. 201–203, 1950.

Carefully organized observations during the Helgoland explosion on April 18, 1947, have clarified many questions concerning the structure of the earth's crust to a depth of 40 or 50 km. Seismic waves, produced by this explosion and accurately recorded, penetrated the ground deeper than ever before, attaining a velocity of about 8 km./sec. The upper boundary of the layer carrying these waves was at a depth of 26±2 km. The mechanical energy involved in seismic waves by this explosion is calculated as equal to 10^{17} ergs, whereas the total thermal energy of the explosives used was about 1.3×10^{20} ergs. The similar explosion produced by an atomic bomb on Bikini evolved a mechanical effect equal to about 10^{19} ergs, comparable with a natural earthquake of 5.5 magnitude.—*S. T. V.*

12185. Reich, Hermann. Geologische Ergebnisse der seismischen Beobachtungen der Sprengung auf Helgoland [Geological results of the seismic observations of the Helgoland explosion]: Geol. Jahrb. 1943–48, Band 64, pp. 243–266, 1950.

Seismic observations of the Helgoland explosion of April 18, 1947, provided important evidence on the structure of the continental shield. This was found to consist of three separate layers. The uppermost is a layer of granite, the seat of the most important thermal anomalies caused by radioactivity and physico-chemical processes, about 10 km. thick or less. The next layer is gabbro, characterized by greater mechanical strength and by less-marked faulting. This layer is the source of eruptive products brought to the surface by volcanic activity. It overlies the third, peridotite, layer.

The discontinuous character of the stratification of the crust of the earth was shown by the form of the travel-time curve which is not a curved line, but a combination of straight segments. The velocities of seismic waves determined by these observations were 5,400 m./sec. in the upper layer, 6,400 m./sec. in the middle layer, and 8,200 m./sec. in the lowest one. The depth of the granite layer is about 10 km., that of the gabbro about 30 km., and that of the peridotite undetermined.—*S. T. V.*

12186. Pettersson, Hans. Exploring the ocean floor: Sci. Am. v. 183, no. 2, pp. 42–44, 1950.

An account of the 1947–48 expedition of the Albatross (*See also* Geophys. Abstract 11781). Some 200 deep-ocean sediment cores with total length of more than a mile, records of 400 depth charges indicating thickness of sediments, several thousand water samples, tens of thousands of temperature measurements to great depths, and echograms for 17,000 miles of ocean bottom are included in the data obtained.—*M. C. R.*

12187. Ewing, Maurice, Worzel, J. L., Hersey, J. B., Press, Frank and Hamilton, G. R. Seismic refraction measurements in the North Atlantic Ocean basin: Seismol. Soc. America Bull., v. 40, no. 3, pp. 233–242, 1950.

A reversed refraction profile was made at 34° N. lat., 66°30′ W. long. 120 miles northwest of Bermuda, in 2,800 fathoms of water. A velocity of 24,800 ft./sec. (7.58 km./sec.) may represent the lower part of the intermediate layer or the basement. No velocity was determined for the sedimentary cover. Using 5,600 ft./sec. (1.70 km./sec.) for this layer a thickness of 4,500 ft. was computed. (*See also* Geophys. Abstract 11730).—*M. C. R.*

12188. **Ewing, Maurice, Worzel, J. L., Steenland, N. C. and Press, Frank.** Geophysical investigations in the emerged and submerged Atlantic Coastal Plain: Part V. Woods Hole, New York, and Cape May Sections: Geol. Soc. America Bull., v. 61, no. 9, pp. 877–892, 1950.

Three seismic refraction profiles along lines approximately perpendicular to the trend of the continental shelf and extended to the edge of the shelf were made near Cape May, N. J., New York, N. Y., and Woods Hole, Mass. Six sea stations were occupied on the Woods Hole and New York profiles and four on the Cape May profile. Reverse profiles were made at all stations. An unconsolidated layer with velocity of about 5,800 ft./sec., a semiconsolidated layer with velocity about 11,500 ft./sec., and a layer considered to be the basement with velocity about 18,000 ft./sec. were found in each traverse. On the Cape May traverse the thickness of the sedimentary column increases from 5,000 feet near the beach to about 16,000 feet near the edge of the shelf. The basement gradually deepened seaward on the Woods Hole profile. Seaward dips of approximately 6° and 4° were found about 10 miles offshore on the Cape May profile and about 30 miles offshore at New York. On both these profiles the basement deepened gradually seaword beyond these slopes, then reversed, shoaling somewhat toward the seaward ends.—*M. C. R.*

12189. **Di Filippo, Domenico, and Marcelli, L.** La "magnitudo" dei terremoti e la sua determinazione nella stazione sismica di Roma [The magnitude of earthquakes and its determination at the Rome seismological station]: Annali Geofis., v. 2, no. 4, pp. 486–492, 1949.

A formula for determining the magnitude of an earthquake was derived for use at the Rome station by using data on 65 earthquakes for which magnitudes had been determined at Pasadena and Strasbourg. The formula ($M = \log A + 1.526 \log \Delta + 2.439$) is valid for distances greater than 15°.—*S. T. V.*

12190. **Gutenberg, Beno.** Earthquakes in North America: Science, v. 111, no. 2883, pp. 319–324, 1950.

The principal zones of seismic activity in the world and of North American earthquakes are briefly reviewed. Statistically speaking, about 5 great shocks (magnitude $\geqq 7\frac{3}{4}$) and 18 major earthquakes (magnitude 7 to 7.7) per century can be expected in the Pacific area of the United States, about 14 great and 15 major shocks in Alaska and the Aleutian Islands, and about 11 major shocks in central, eastern, and northern North America. Investigations of the direction of movement during shocks and of the relation of earthquakes and aftershock sequences contribute data on processes leading to earthquakes, but, it is pointed out, hypotheses concerning the structure and process in the earth's crust have become less certain as data accumulate and the number of recognized unsolved problems is increasing.—*M. C. R.*

12191. **Mihailovič, Jelenko.** The seismicity of the Balkan Peninsula [in Serbian with summary in French]: Annales Géol. Péninsule Balkanique, tome 18, pp. 187–202, 1950.

This is a review of the more important earthquakes of the Balkan Peninsula and the Aegean Sea from 479 B. C. to the present time. In this long series of seismic cataclysms there was an interval of 154 years (1084–1236) of seismic calm.

Of the epicenters of the earthquakes, 87 are located in the basin of the Sea of Marmara, 110 in the Aegean Sea, 207 on the eastern shore of the peninsula, 113 on the western coast, and 53 in the interior of the peninsula. The eastern earthquakes were caused by tectonic movements connected with the submergence of the Aegean Sea, which has left the structure of the area in a very unstable state. The Mediterranean geosyncline, a continuous process, but of insignificant intensity.—*S. T. V.*

12192. Nedeljkovič, R. L. The seismicity of Banat [in Yugoslav with summary in Russian and French]: Annales Géol. Péninsule Balkanique, tome 18, pp. 203–218, 1950.

Since 1865, 314 earthquakes have occurred in the Banat region, of which 208 epicenters have been located there. The intensity of several shocks reached degree 8 and 9. The sources of seismic energy can be divided into two distinct classes, some of the earthquakes being caused by phenomena taking place deep in Pannonian Basin, others being caused by dislocations in the higher layers. Five separate periods of seismic activity, each embracing several shocks, were recorded in this region. The earthquakes are seldom accompanied by brontides.—*S. T. V.*

12193. Uzelač, Miroslava. Seismic characteristics of the Srem region [in Serbian with summary in French and Russian]: Annales Géol. Péninsule Balkanique, tome 18, pp. 219–230, 1950.

The region studied is the valley of the lower Sava, covered with Neogene and Quaternary sediments, over which rises the ridge of Fruška Gora composed of Paleozoic schists and of upper Cretaceous formations. Earthquakes of the Srem region, as recorded from 1739 up to the present, originate in this ridge, which stretches for some 80 km. in a northwesterly direction. The principal seismic area is limited by Beočin, Crveni Čot, Jazak, Sremski Karlovci, and Krušedol. Several earthquakes of destructive intensity and of a pronounced local character occurred here. Two loci of hypocenters of these earthquakes have been found, one in the Paleozoic mass, the other in dislocations of the Tertiary and Quaternary sediments.—*S. T. V.*

12194. Fontseré, Eduardo. Los temblores de tierra Catalanes del año 1945 [Earthquakes in Catalonia during 1945]: R. Acad. Cien. y Artes de Barcelona, Bol. 34, pp. 373–378, 1946.

During 1945 only three relatively important earthquakes occurred in Catalonia: on July 9, a weak local shock; on July 17, a shock of intensity 3–4 on the Mercalli scale with epicenter about 125 km. southwest of Barcelona; on October 22, a shock of maximum intensity 4 with epicenter 144 km. from Barcelona near the village of Llesúy.—*S. T. V.*

12195. Fontseré, Eduardo. Los temblores de tierra Catalanes de los años 1946 y 1947 [Earthquakes in Catalonia during 1946 and 1947]: R. Acad. Ciencias y Artes de Barcelona, Bol. 36, pp. 73–78, 1949.

Ten earthquakes were observed during 1946 and 1947 in Catalonia, only one reaching intensity 4. Most of them were of local origin, but the epicenter of the shock of December 13, 1947, was in southwestern France, some 190 km. from the Fabra Observatory at Barcelona.—*S. T. V.*

12196. Gimeno Riutort, Antonio. Movimientos sismicos en España durante 1947 [Seismic events in Spain during 1947]: R. Soc. Española Historia Nat. Bol., v. 47, no. 7–8, pp. 485–494, 1950.

Of the 206 earthquakes which occurred in Spain during 1947, 29 were felt and 177 were registered only by seismographs. One earthquake reached intensity 6, six were of intensity 5, and six of intensity 4. Southern Spain has shown greatest seismicity with many earthquakes having their epicenters beneath the Mediterranean Sea.—*S. T. V.*

12197. Ylanan, C. W. The northern Luzon earthquake December 29, 1949: The Philippine geologist, v. 4, no. 2, pp. 1–16, 1950.

The Luzon earthquake of December 29, 1949, reached an intensity 8 near its epicenter. The epicenter was located instrumentally near 17°00′ N. lat., 121°38′ E. long. More than 50 aftershocks were felt, some of them from a different epicenter. The earthquake was of tectonic origin, no volcanic activity being noticed in connection with it. The report contains a brief seismic history and description of the geology of the island of Luzon.—*S. T. V.*

12198. Parker, G. G., and Stringfield, V. T. Effects of earthquakes, trains, tides, winds, and atmospheric pressure changes on water in the geologic formations of southern Florida: Econ. Geology, v. 45, no. 5, pp. 441–460, 1950.

Small fluctuations of water level in wells may be caused by tides, atmospheric pressure, winds, earthquakes, and passing trains, and will often mask fluctuations caused by ground-water movements or changes in storage in an aquifer. Artesian aquifers respond to barometric changes and tidal loading in varying amounts depending on their elasticity and compressibility. Nonartesian aquifers such as the shallow wells of the Miami area are affected by tides, but only under special geologic conditions by barometric changes. Wind may produce minor variations in barometric pressure in the well housing. Earthquake waves from all parts of the world produce marked fluctuation. The greatest fluctuation observed was 4.5 feet in a Miami well during an earthquake 750 miles away. Heavy trains occasionally cause similar though not as symmetrical fluctuations of a minor nature.—*E. K.*

12199. Werner, P. W., and Sundquist, K. J. On hydrodynamic earthquake effects: Am. Geophys. Union Trans., v. 30, no. 5, pp. 636–658, 1949.

This paper discusses the hydrodynamic effect of horizontal earthquake action for the most common types of artificial hydraulic vessels with rigid walls. The mathematical theory is presented for the case of two- or three-dimensional flow assuming the earthquake to be manifest in harmonic vibrations either parallel or transverse to the direction of the generating axis. The expressions for the displacement and the dynamic water pressure are obtained by finding solutions of the general differential equation of a compressible fluid which satisfy the prescribed boundary conditions. The pressure on the walls is calculated and the results presented in diagrams for various ratios of the configuration dimensions and for particular compressibilities. The conditions for resonance are discussed for the various cases. A graphical procedure with illustrations is given for the two-dimensional flow of an incompressible fluid.—*I. Z.*

12200. Coulomb, Jean. L'agitation microséismique [Microseisms]: Annales Géophys., tome 6, no. 2, pp. 115–116, 1950.

Different phenomena are often meant by the term microseisms. A sensitive seismometer of short natural frequency installed near a city or industrial center records seismic waves of a period of a fraction of a second, which almost disappear on holidays and during the night. Gusts of wind may produce microseisms of a period of 15 or more seconds and of a very irregular shape. Surf on a rocky shore also produces microseisms, and the freezing of the ground around an observatory at distances to 200 km. will cause irregular microseisms of over one minute period.

The most interesting microseisms are those of 4- to 10-second period usually noticeable during several days in succession and reaching their greatest intensity during winter months. These microseisms consist of progressive waves with a velocity from 1.9–2.7 km./sec. formed around barometric lows, whose position can be determined by observations of tripartite stations.

These microseismic waves are in the main Rayleigh waves, but very seldom appear in pure form because of reflections on the surface layers of the ground.

The propagation of these microseismic waves over continents or over oceans is different. Certain investigators think these waves attain their maxima over continental shelves where a change of frequency is observed.— *S. T. V.*

12201. Hardtwig, Edwin. Die Bodenunruhe oder Mikroseismic [Ground unrest or microseisms]: Forschungen u. Fortsch. Jahrg. 24, Heft 9–10, pp. 113–117, 1948.

A review of the various kinds of microseisms and theories of their origin.— *S. T. V.*

12202. Lynch, J. J. An investigation of two-second microseisms associated with cold fronts and a new method for tracking the cold front center: Am. Geophys. Union Trans., v. 31, no. 4, pp. 525–528, 1950.

Studies of two-second microseisms at Fordham University are reveiwed (*See also* Geophys. Abstracts 11281, 11282). Evidence is presented for a microseismic source southwest of New York and of wave trains identifiable between two stations 6 miles apart with a velocity of less than 1 mile a second. A method is being worked out in which the microseisms are recorded on an oscilloscope and the phase difference between pairs of stations read along the axis of the observed Lissajous ellipse.—*M. C. R.*

ELECTRICITY

12203. Kebuladze, V. V., and Bukhnikashvili, A. V. Organization of the daily and short cycle variations of telluric currents at Dusheti [in Russian]: Akad. Nauk SSSR Izv., Ser. geog. i geofiz., v. 13, no. 5, pp. 440–454, 1949.

Since 1947 continuous registration of telluric currents has been made. Twenty-one profiles about 1 km. long and 50 meters apart were recorded. Before continuous observations of regional telluric currents were made, the chosen area was thoroughly explored for possible local magnetic anomalies, for the presence of disturbing currents from industrial or other origins, and for the sources of geochemical generation of potential differences. Four hundred and ninety determinations of electrical resistivity were made at different points of the area and

1,060 measurements of the potential differences. No local anomalies of magnetic or electric properties were found. Comparison with the magnetograms of the Dusheti Magnetic Observatory indicates a close correlation between the variation of the latitudinal component of the telluric currents and the variation of the horizontal magnetic vector. Either of the phenomena can be represented by a sinusoidal curve with maxima near 2–3 hours and 16–17 hours and minima near 23–1 and 8–9 hours, local time.—*S. T. V.*

12204. Schmitz, H. P. Zur Interpretation von Erdstrommessungen [Interpretation of earth-current measurements]: Zeitschr. Meteorol., Band. 2, Heft 7–8, pp. 210–216, 1948. (Reviewed by H. G. Macht, Jour. Geophys. Research, v. 54, no. 1, pp. 69–70, 1949.)

A theoretical study of earth currents in the light of principles of electrodynamics and observations on underground cables shows that considerable additional electric fields may be generated at crustal boundaries, especially at shores, and also by external potential fields, such as the daily geomagnetic variations. Both types of fields are examined mathematically, and it is found that the primary magnetically induced field is equal to, or even smaller than, the partial field due to electrostatic boundary effects. Possible existence of such additional geoelectric fields makes it necessary to take them into account in measurements of earth currents. Although the ratio between the currents in the soil and in the cable used for measurements generally equals that of the corresponding conductivities, this does not hold for additional fields in the soil and in the cable when the conductivity of the soil varies along the length of the cable. It is therefore preferable to make measurements of earth currents in homogeneous soil and to use short cables. In heterogeneous ground, relative measurements of such currents over long cables are unreliable, and absolute determinations over long cables are useless.—*M. C. R.*

12205. Poldini, E. Interprétation tectonique des variations du champ tellurique [Tectonic meaning of the variations of the telluric field]: Schweizer. Vereinigung Pet.-Geologen u. Ing., Bull., v. 17, no. 52, pp. 1–4, 1950.

Telluric currents are defined as electric currents which can be observed spreading over the earth's surface with regular variations of direction and intensity. Produced by planetary influences, their patterns over a given region are influenced by the geological structure of the underground.

Typical examples are given of local patterns such as those to be found over an upwarping of a nonconductive underground stratum, over an intrusion of a nonconductive bed in a conductive series of marl, over a folding formed of diapyric salt, or over a calcareous bed topped by erosion and covered in later transgression. More complicated patterns of telluric currents and their tectonic interpretation are also discussed.—*S. T. V.*

RADIOACTIVITY

12206. Korff, S. A. Counters: Sci. Am., v. 183, no. 1, pp. 40–43, 1950.

A semitechnical account of the principles and uses of Geiger counters.—*M. C. R.*

12207. Korff, S. A. Proportional counters: Nucleonics, v. 6, no. 6, pp. 5–10, 36, 1950.

The operating characteristics of proportional counters are discussed and the conditions for optimum design determined. The amplification factors as functions of cylinder voltage and the filling gas mixture, dead-time comparison, and properties of the vacuum-tube amplifier are discussed. With an appropriate arrangement of different parts, the number of pulses per second that can be counted is at least 10 times greater than obtainable with Geiger counters operated in the conventional way.—*S. T. V.*

12208. Rohrer, R. H. A portable high-speed Geiger counter for geologic work in Georgia: Georgia Geol. Survey Bull. 56, pp. 117–129, 1950.

A modified Geiger counter has been developed at Emory University to shorten the time required for radioactivity measurements of rocks and solids. It consists of a large Geiger tube and head phones in the least expensive counting sets. Much better results can be obtained by substituting an electrically driven mechanical recorder for the head phones, or using head phones and recorders. A 3-minute observation is sufficient to obtain reliable data using the new instrument, where more than 7 hours at one station are required to attain the same reliability with standard equipment. Wiring diagrams and characteristic curves are given.—*S. T. V.*

12209. Jeffreys, Harold. On the radioactivity of potassium: Annales Géophys., tome 6, no. 1, pp. 10–17, 1950.

The rate of decay of K^{40} to Ca^{40} has been fairly well determined as $(0.51 \pm 0.04)/10^9$ year, but there are inconsistencies in the rate of decay to A^{40}. Ahrens' and Evans' data for the accumulation of Ca in old micas indicate $\lambda_e = (1.91 \pm 0.16)/10^9$ years. From Borst and Floyd's determination of A in KCl, a least possible value of $0.36/10^9$ years is determined. The amount of argon in the atmosphere may be consistent with the former value if the age of the earth is 2,100 million years and if all granites that have not been exposed retain all their argon. For greater ages, such as Holmes' estimate of 3,300 million years, λ_e would have to be less than $1.4/10^9$ years. Even the latter value would make general solidification impossible more than 1,400 million years ago unless K is more closely concentrated at the surface than usually supposed.—*M. C. R.*

12210. Guimarães, Djalma. Chronologie geologique fondée sur la désintégration atomique des minéraux radioactifs [Geologic chronology based on the atomic disintegration of radioactive minerals]: Géol. Soc. France Bull., tome 19, nos. 7–8–9, pp. 657–668, 1949.

The method of age determination of rocks based on the relation of the lead content to the amount of uranium and thorium, is often used without taking into account that quite often the parent rock was not formed as one magmatic phase but is the result of a progressive granitization. Moreover, the geochemical mobility of uranium and solubility of its oxides in alkaline carbonated complexes can cause migration of uranium and other rare elements. The use of monazite as a key mineral in age determinations is suggested as giving most reliable data.—*S. T. V.*

12211. White, W. C. and Yagoda, Herman. Abundance of N^{15} in the nitrogen occluded in radioactive minerals: Science, v. 111, no. 2882, pp. 307–308, 1950.

The isotopic ratio of N^{15} to N^{14} in occluded gases in radioactive minerals, investigated by means of the mass spectrometer, was found to be higher than in samples of atmospheric air or in nitrogen isolated from nitrogenous compounds. The percentage of N^{15} abundance seems to be roughly proportional to the geological age of the mineral. It is suggested that the nitrogen was present at the time of formation of the mineral and that the N^{15} abundance was increased by the more rapid diffusion of N^{14}.—*M. C. R.*

12212. Holmes, Arthur. Lead isotopes and the age of the earth: Nature, v. 163, pp. 453–456, 1949.

Points raised by Jeffreys (*see* Geophys. Abstract 11575) are discussed. It is indicated that some of Jeffreys' work is wrong in principle and other parts contain arithmetical errors. It is agreed, however, that further isotopic analyses are needed to improve the precision of the figures.—*M. C. R.*

12213. Szalay, A. and Csongor, Eve. Determination of radioactive content of rocks by means of Geiger-Müller counters: Science, v. 109, no. 1824, pp. 146–147, 1949.

A direct approximating method for determination of the radioactive content of rocks with Geiger-Müller counters was developed during a survey in the Velence Mountains [Velence Hegy] of Hungary. Brass counters of the self-quenching type, filled with 100 mm. argon and 10 mm. alcohol vapor, used in connection with battery amplifiers, were placed either on the surface of the rock or in a shallow borehole. A 2 mm. lead shield was used to absorb the soft components of gamma radiation. Preliminary results showed that the rock counting rate was about six times higher in the bore and two to three times higher at the surface than the cosmic radiation.

Precise formulas are developed for expressing the radioactivity in terms of thorium-gamma equivalents. For practical purposes, the following approximate formula, expressed in grams of uranium equivalents per grams of rock, may be used: $c=1.4\times10^{-5}\ J/LD$, c being the concentration of radioactive substances, J the counting rate in minutes, and L the length and D the diameter in centimeters of the brass cathode of the counter tube. For measurements on the surface, the counting rate must be multiplied by a correction factor of 2 to 2.2. If any Geiger-Müller counter of commercial dimensions shielded by 2 mm. lead is placed against the rock wall, and the observed counting rate (minus cosmic radiation) is x times the rate of cosmic radiation for the same counter, then the average uranium concentration is x times 25 g. U/ metric ton of rock.—*M. C. R.*

12214. Tiratsoo, E. N. The radioactivity of sediments, pts. 1–4: Petroleum, v. 12, no. 3, pp. 61–65; no. 5, pp. 117–122; no. 7, pp. 166–169; no. 12, pp. 313–315, 1949.

Various laboratory methods for determining the radioactivity of rocks are described, including the ionization chamber techniques in which the radon or thoron content of a rock sample is measured by releasing its gases by fusion, solution, or boiling, and passing them into the chamber for discharge in an electroscope, and the determination of potassium content in rocks and liquids by measuring beta radiation. Absorption coefficients for gamma rays in rock can be calculated from measurements made with Geiger-Müller counters of the radiation passing from a known source through progressively increased thicknesses of rock samples until no further change in count is observed. Coefficients for sandstone, shale, marl, and limestone are 0.34, 0.34, 0.11, and 0.24 for energies of about 1.50 m. e. v.—*M. C. R.*

12215. Tiratsoo, E. N. Radioactivity survey in southwest France: Am. Assoc. Petroleum Geologists Bull., v. 34, no. 4, pp. 742–754, 1950.

An investigation by measurements of gamma radiation by sensitive portable Geiger-Müller counters in a part of the Aquitaine sedimentary basin of southwest France in the summer of 1947 is described. In the coastal area between Biarritz and Saint-Jean-de-Luz, a plug of gypsiferous Keuper shale is exposed between two limestones. It has been suggested that this plug underlies the coast for more than a mile and that two fingers from it reach the surface at the Rochers de Peyreblanque and Chaillac. The objectives of the survey were to test whether the two outcrops could be proved or disproved to have a common origin, whether either or both showed an increase of radioactivity at the surface which would serve to differentiate them from the surrounding strata, and whether any trace could be found of the main body of the plug. Traverses were made from Cap Martin to Guéthary and over the supposed area of the plug. A series of stations was occupied along each line of traverse; ten minute counts were taken at each point, the apparatus being held three feet above ground. Corrections for background effect of cosmic rays were made by establishing the mean basic value of the background for each day. No evidence was found that the "ophite" outcropping at the Rochers de Peyreblanque is the same age as the plug. The Keuper plug showed remarkably high radioactivity, reaching a peak near its geographic center. Subsequent laboratory tests indicated that most of the activity was concentrated in gray marl. No evidence was found of any underlying mass along the coast, but this was expected if the mass was buried at any depth.—*M. C. R.*

12216. Hée, Arlette, Jarovoy, Michel, and Kleiber, Joseph. Study by the photographic method of active deposits of various radioactive substances: Acad. Sci. Paris. Comptes Rendus, tome 230, no. 1, pp. 1520–1522, 1950.

Colorado carnotite, Tonkin autunite, and Ceylon thorianite samples, electrically deposited on metal discs, were placed in contact with Ilford plates for periods of 4 hours to 4 days. From a statistical study of the lengths of the alpha tracks in the plates after the various times of exposure, the radioactive elements were identified.—*M. C. R.*

HEAT

12217. Birch, Francis. Flow of heat in the Front Range, Colorado: Geol. Soc. America Bull., v. 61, no. 6, pp. 567–634, 1950.

Seventy observations of temperatures from the Alva B. Adams Tunnel under Rocky Mountain National Park were reduced to find the flow of heat. Corrections have been applied for the topography on several different hypotheses regarding physiographic history. The corrected vertical gradient lies between 24° C./km. and 20° C./km., with an uncertainty of about 1° C./km. resulting from lack of reliable data on surface temperature. Laboratory measurements of 123 samples indicate a mean value of conductivity of 0.008 cal./cm. sec. deg. Variations with rock type and position along the tunnel were found to be insignificant. Heat flow is computed as between 1.6 and 1.9×10^{-6} cal./cm.^{2} sec. with a "best value" of 1.7×10^{-6} cal./cm.^{2} sec. differing significantly from normal sea-level crust values of about 1.1×10^{-6} cal./cm.^{2} sec. The difference may be accounted for in terms of mountain roots with mean radioactivity of the same order as that of granites or intermediate rocks. (For abstract published in advance, *see* Geophys. Abstract 11332.)—*M. C. R.*

12218. White, D. E. and Brannock, W. W. The sources of heat and water supply of thermal springs, with particular reference to Steamboat Springs, Nevada: Am. Geophys. Union Trans., v. 31, no. 4, pp. 566–574, 1950.

The origin of a spring system may be indicated by temperature relations, mineral content of the thermal water, composition of associated gases, variations in spring discharges and water levels, isotopic composition of spring and meteoric waters, and regional and local geology, in particular the age and extent of volcanic rocks. Evaluation of these factors with respect to Steamboat Springs indicates a volcanic origin. Measurements in thermal wells show very high temperatures at shallow depths, and computations indicate a gradient of 1° C. per 0.33 to 0.82 meters of depth, at least 40 times the normal increase. Gases evolved from the springs and the mineral content of the water suggest a volcanic origin. A structural and temporal connection with volcanism is suggested by the occurrence of the springs on the line of possible structural weakness connecting several rhyolite domes. A three-dimensional picture of the Steamboat Springs system indicates meteoric water migrates downward and toward the core of the system, with stratigraphic and structural control, where it mixes with rising volcanic water. This migration is caused by differences in density related to temperature. Artesian conditions are not essential.—*M. C. R.*

12219. Nathan, Hans. Geologische Ergebnisse der Erdolbohrungen im Bayerischen Innviertel [Geological findings from exploratory drilling for oil in the Bavarian Innviertel]: Geologica Bavarica, no. 1, 68 pp., 1949.

This is the first issue of the report on the geophysical, geochemical, mineralogical, and paleontological studies made in connection with drilling in the Innviertel. Temperature measurements made at different depths indicate the reciprocal geothermal gradient down to a depth of 150 meters varies from 15.7 to 21.1 meters; to a depth of 1,140 meters, 25.2 meters; and to a depth of 1,405 meters, 27.3 meters.—*S. T. V.*

VOLCANOLOGY

12220. Bruet, E. La Soufrière de la Guadeloupe. Contribution a l'étude des édifices volcaniques peléens [La Soufrière of Guadeloupe. Contribution to the study of pelean volcanic structures]: Annales Géophys., tome 6, no. 1, pp. 51–64, 1950.

Examination of La Soufrière casts doubt on the existence of domes in pelean structures. Erosion of deeply rooted spines has resulted in cones with slope angles of 37° at Pelée and 41° at La Soufrière.—*M. C. R.*

TECTONOPHYSICS

12221. Bucher, W. H. The crust of the earth: Sci. Am., v. 182, no. 5, pp. 32–41, 1950.

A review of the structure of the crust of the earth and of changing ideas concerning it in recent years.—*M. C. R.*

12222. Bucher, W. H. Megatectonics and geophysics: Am. Geophys. Union Trans., v. 31, no. 4, pp. 495–507, 1950.

This is the presidential address delivered at the thirty-first annual meeting of the Union. The growth of geologic thinking from the mapping of local geology to the nature of the visible part of the earth's crust as a whole is reviewed. Three basic concepts are outlined: geosynclines as loci of orogenic deformation; ultramafic rocks as initial products of orogeny; and metamorphism and granite as products of mature orogeny. It is suggested that the original crust of the earth was alkaline basalt and that the light sialic continents are the product of orogeny. Orogenic belts come into being by local failure of the crust, and the growth of continents takes place by addition at the margins.—*M. C. R.*

12223. Matschinski, Mathias. La formation des continents et des forces géodynamiques [Formation of continents and geodynamic forces]: Acad. Sci. Paris Comptes Rendus, tome 230, no. 21, pp. 1882–1884, 1950.

Cooling of the earth produced a crust over its surface. This physico-chemical transformation of the initially fluid substance was accompanied by certain secondary reheating of small absolute intensity, but important as a local tectonic factor. Forces produced by reheating were sufficient for rupturing the crust into several pieces, the future continental blocks. The spreading of the produced cracks was probably very slow and continued up to the time of the development of living matter. The continents did not drift apart, as in Wegener's theory, but simply contracted without changing the position of their centroids. Computations of the forces produced by thermodynamic processes are presented to show that these forces are sufficient for producing the rupture of the crust.—*S. T. V.*

12224. Vening Meinesz, F. A. Earth's crust deformations in geosynclines: K. Nederland Akad. Wetensch. Proc., v. 53, no. 1, pp. 27–46, 1950.

The belts of strong negative gravity anomalies in the Indonesian, Caribbean, and Japanese regions have led to the hypothesis that in these areas the earth's crust has in recent geological periods buckled downwards, forming a large bulge of crustal matter at the lower boundary of the crust. This crustal bulge, being of lower density, has caused the deficiency of mass revealed by the anomalies. The problem of how and to what extent this deformation had a plastic or elastic character is analyzed. By assuming a plastic deformation throughout the whole process, a satisfactory explanation can be given of the downbulging of the crust. At the same time, this assumption explains the intricate pattern of the belts in Indonesia and probably in other orogenic areas. The paper contains extensive calculations, based on the theory of elasticity, referring to possible buckling of a rigid crust of a thickness of 30 kilometers.—*S. T. V.*

12225. Wilson, J. Tuzo. Some major structures of the Canadian Shield: Canadian Min. Met. Bull., v. 42, pp. 543–554, 1949.

The Canadian Shield is divided into provinces that are believed to represent former mountain belts. Special emphasis is placed on radioactive age determinations, the relations of the Archean to the Proterozoic rocks, and the structure of the Grenville province.—*M. C. R.*

12226. King, P. B. Tectonic framework of southeastern United States: Am. Assoc. Petroleum Geologists Bull., v. 34, no. 4, pp. 635–671, 1950.

The tectonics of the southeastern states are dominated by the mountain system to which belong the structures of the Appalachian Highlands and Ouachita Mountains and other areas west of the Mississippi embayment, as well as structures concealed by post-orogenic coastal plain sediments of the Mesozoic and Cenozoic.

The Appalachian Highlands are divisible from northwest to southeast into five provinces which persist for great distances along the strike. On the northwest flank of the system the gently deformed Cumberland and Alleghany plateaus constitute a foreland area. The Valley and Ridge province, consisting of sharply folded and faulted Paleozoic sediments is still marginal to zones farther southeast. The Blue Ridge province is composed of metamorphosed and strongly folded older Paleozoic and pre-Cambrian rocks. The system's central axis is believed to occur in the adjacent metamorphic and plutonic zone which consists of gneisses and other thoroughly metamorphosed rocks invaded by granite plutons. A double row of ultramafic instrusive rocks in this zone and an observed southeast assymmetry of the structures on the southeast are cited as evidence. This concept is also supported by the less metamorphosed rocks of the last zone, and by the little folded and unmetamorphosed rocks beneath the Mesozoic of Florida which constitute southeast foreland of the system. The bulk of the Appalachian deformation may have preceded the Permian, contrary to the widely held concept of the Appalachian revolution. Thick wedges of clastic sediments are evidence for orogeny commencing in the Middle Ordovician.

The relations between the Appalachian and Ouachita systems are obscured by the intervening coastal plain sediments. Deep drilling in Mississippi and Alabama revealed subsurface extensions of the systems but leaves the nature of their junction uncertain. It is tentatively suggested that the Ouachita system is a westward extension of an interior belt of the Appalachian system which has been thrust northward to a moderate extent over the westward extension of the Valley and Ridge province, which may reappear as the Wichita and Arbuckle systems in Oklahoma.—*E. K.*

12227. Rodgers, John. Mechanics of Appalachian folding as illustrated by Sequatchie Anticline, Tennessee and Alabama: Am. Assoc. Petroleum Geologists Bull., v. 34, No. 4, pp. 672–681, 1950.

There is controversy as to whether the folds of the Appalachian Valley and Ridge province reach to the crystalline basement and are controlled by it, or whether they are independent of the basement, all deformation taking place within the overlying sediments. The Sequatchie anticline of Tennessee and Alabama is isolated from the Valley and Ridge folds to the southeast by a strip of horizontal plateau and, according to proponents of the first theory, must have been formed by upthrust from a competent basement. The other interpretation requires transverse faults at each end analogous to the Pine Mountain overthrust to the northeast. These faults exist, although their significance is not recognized. Transverse movement seems to have occurred along weak layers such as the Conasauga shale and buckled the overlying carbonate rocks to form the present anticline and at least two windows, comparable with the oil-bearing windows of Lee County, Va., where the thrust plane reaches the surface.—*E. K.*

12228. Weaver, Paul. Variations in history of continental shelves: Am. Assoc. Petroleum Geologists Bull., v. 34, no. 3, pp. 351–360, 1950.

A locus of tectonic movement is postulated at the outer edge of the continental shelf, rather than at a hinge line along the shore accompanied by extensive sedimentation on the shelf. The continental shelf and adjacent land seem to be a structural unit, differing only in their respective erosional agencies. The shelf is narrow where the coast rises steeply, and is correspondingly broad where there is a wide coastal plain, as illustrated by the Gulf of Mexico. There is a lack of stratigraphic evidence in the Gulf Coastal Plain for a wedge of younger sediments offshore. The continental slopes at the outer edge of the shelf are either steep, simple inclines striking lineally for great distances, or gentle, and compound inclines with less pronounced lineal character but much local relief. Both types of slope are believed to be the structural expression of downfaulting of the Gulf of Mexico with respect to the outer edge of the continental shelf. The material displaced by such a movement might have found outlet as the abundant extrusives in Mexico.—*E. K.*

12229. Emery, K. O. A suggested origin of continental slopes and of submarine canyons: Geol. Mag., v. 87, no. 2, pp. 102–104, 1950.

The temporary upbulging of the continental margins above sea level may be produced by thrusting along a shear plane at the margin, as suggested by the presence of seismic activity and negative gravity anomalies. Erosion might then incise canyons or, if long continued, even produce peneplanation before isostatic readjustment of the margins, probably by downwarping, brought about their present submergence. The Atlantic canyons were probably formed earlier than those of the Pacific.—*E. K.*

12230. Zen'kovich, V. P., and Vladimirov, A. T. Recent sinking of the coast of western Kamchatka [in Russian]: Akad. Nauk SSSR Doklady, v. 72, no. 4, pp. 753–754, 1950.

The sinking of the coast of the southern tip of Kamchatka Peninsula, determined by a recent geodetic survey, was confirmed by exploratory drilling at several places which penetrated peat deposits at a depth of over 20 meters below the ocean level and typical continental gravel conglomerates at depths of 17 to 50 meters.—*S. T. V.*

12231. Hughes, D. S., and Jones, H. J. Variation of elastic moduli of igneous rocks with pressure and temperature: Geol. Soc. America Bull., v. 61, no. 8, pp. 843–856, 1950.

Direct measurements of the dilatational and rotational elastic wave velocities in igneous rocks were made using recently developed pulse methods. Sharp, elastic pulses were excited in rocks by D. C. pulses, impressed on 5.0 mc. x-cut piezoelectric quartz crystals. The amplified output of similar detector crystals was photographed by using oscilloscopes. Two principal arrivals of energy were precisely timed, and from the travel times the dilatational and elastic velocities were computed, with an accuracy greater than 1 percent. Assuming homogeneous, isotropic media, elastic constants were then computed from the velocity data. The sample assembly was placed in a pressure cell, surrounded by an oil bath; thus measurements at high pressures and temperatures could readily be made. Measurements were made in the pressure range 1–1,100 kg./cm.^{2} and the temperature range 30–150° C. Samples of granite, quartz monzonite, diorite, andesite, and norite were studied both while enclosed in impervious copper jackets and while exposed to the fluid pressure medium. The enclosed samples had relatively great increases of velocity with pressure at the low pressures, presumably because of closing of initial pore space; the rate of increase became small and essentially linear at higher confining pressures. Open samples had small, linear rates of increase of velocity over the entire pressure range. Pressure increase was accompanied by increase of wave velocities and elastic constants in all cases. Increase of temperature was accompanied by decrease in velocities and moduli. Changes of Poisson's ratio with pressure and temperature were small and erratic.

The reasonably good agreement of the present work at effective frequencies of 2–6 megacycles with earlier measurements at low frequencies suggests that for rocks the effect of frequency upon velocity is negligible, although the data are, as yet, inconclusive.—*J. R. B.*

12232. Hughes, D. S., Blankenship, E. B., and Mims, R. L. Variation of elastic moduli and wave velocity with pressure and temperature in plastics: Jour. Applied Physics, v. 21, no. 4, pp. 294–297, 1950.

The variations in velocity of dilatational waves at pressures up to 15,000 lb/in.^{2} and temperatures from 30° to 90° C. have been measured for samples of polystyrene, Lucite, and polyethylene. The velocity of rotational waves was also measured for polystyrene and Lucite. In polyethylene no trace of a rotational wave could be identified. The computed elastic moduli and Poisson's ratio are listed in tables.

This study is very closely related to that of Geophys. Abstract 12231 in which the method of measurement is discussed.—*J. R. B.*

12233. Seigel, H. O. A theory of fracture of materials and its application to geology: Am. Geophys. Union Trans., v. 31, no. 4, pp. 611–619, 1950.

A generalized extension of Mohr's theory of fracture of materials is developed which encompasses tension as well as shear failure of isotropic media and anisotropic media having a single plane of weakness. The probability of fracture occurring across a given surface element is assumed to be a general function of the limiting normal and tangential stresses across that element in an isotropic medium and, in addition, of the attitude of that element with respect to the plane of weakness in an anistropic medium.

The probable fracture at a point in an isotropic medium is predicted to take place across a pair of conjugate surface elements equally inclined to the direction of the maximum pressure at an angle which is a function of the limiting stress as well as constants of the medium. In anisotropic media failure is predicted generally across a single surface element. Applied to geology the theory accounts for low angle thrust faults, normal faults, tear faults, tension cracks, conjugate fractures, and multiplicity of parallel shears in isotropic rock masses. It also predicts that, with increase in depth, fractures die out, low angle thrusts tend to steepen to 45°, and conjugate faults tend to become orthogonal. In isotropic rock masses, the theory predicts one parallel, rather than two conjugate parallel sets of fractures, recurrent failure along old faults under different stress distributions, and of particular interest to geologists, the lateral displacement of a new fault or shear zone by the plane of weakness previously established by an old fault or shear zone.—*J. R. B.*

INTERNAL CONSTITUTION

12234. Bethune, P. de. L'interieur de la terre [The interior of the earth]: Rev. Questions Scientifiques, pp. 389–413, July 1950.

A review of present knowledge of the internal structure of the earth.—*S. T. V.*

12235. Hardtwig, Erwin. Hypothesen über den Aufbau des Erdinnern [Hypotheses on the internal constitution of the earth]: Forschungen u. Fortschr., Jahrg. 26, Heft 9–10, pp. 123–128, 1950.

Possible causes of discontinuities in the earth, the origin of the terrestrial magnetism, and the physicochemical composition of the earth's core are discussed. The discontinuities are explained not by chemical differences of the composition, but by transition from molecular to metallic phase at a certain critical pressure. Such changes can be produced artificially on such substances as gray and white tin, yellow and metallic arsenic. They take place in the depths of the earth and produce sharp changes in the physical properties of substances involved. A check by astronomical methods of Ramsey's theoretical results applied to the planet Mars indicated good agreement.—*S. T. V.*

EXPLORATION GEOPHYSICS

GENERAL

12236. Eckhardt, E. A. Geophysical activity in 1949: Geophysics, v. 15, no. 3, pp. 400–408, 1950.

This is the report of the Committee on Geophysical Activity of the Society of Exploration Geophysicists. Although a strong downward trend in activity occurred during most of the year, on a world-wide basis geophysical activity in the petroleum industry was on a level with, if not slightly above, 1948. World-wide expenditures by the mining industry for geophysical work were about 38 percent greater in 1949 than in 1948. Expenditures for research and development were almost 41 percent greater in 1949 than in 1948.—*M. C. R.*

12237. The Geophysical Directory, 5th edition, 1950. 196 pp., Houston, Tex., 1950.

This Directory is a comprehensive listing of all companies, organizations, and individuals directly connected with, or engaged in, geophysical exploration for petroleum. Contractors doing geophysical exploration by gravitational, seismic, magnetic, radioactivity, and electrical methods, experts in soil analyses, photography from the air, drilling contractors, cartographers, and surveyors are listed as well as oil companies and individuals who used geophysical services during the years 1940–50. Foreign companies are included.—*S. T. V.*

12238. Jones, W. R., and Williams, David. Minerals and mineral deposits: 248 pp., London, Oxford Univ. Press, 1948.

A chapter on the search for mineral deposits in this book on the systematic description and methods of identification of minerals is devoted chiefly to the geophysical methods of exploration. Magnetic, gravitational, electrical, and radioactivity methods are briefly discussed. The point is made that to interpret the results effectively, it is often essential that the geologist and geophysicist work in close cooperation.—*S. T. V.*

12239. Hvoroslev, M. J. Subsurface exploration and sampling of soils for civil engineering purposes, 521 pp., Vicksburg, U. S. Waterways Experiment Sta., 1949.

This is a report on a research project of the American Society of Civil Engineers, sponsored by the Engineering Foundation, Harvard University, and the U. S. Waterways Experiment Station. It is intended to give the practicing engineer an authoritative reference work on subsurface exploration and sampling of soil and rock. Electrical and seismic methods of subsurface exploration are described. Also described is the "continuous-vibration method" which makes use of vibrations spreading through the ground produced by special vibrators capable of producing impulses of varying frequency and intensity. Most of the report covers sampling methods, including sampling in search for oil and minerals. An extensive bibliography is included.—*S. T. V.*

12240. Breyer, Friedrich. Der Salzstock von Etzel [The salt dome of Etzel]: Erdöl u. Kohle, 3rd Jahrg., Heft 7, pp. 153–162, 1950.

The history of geophysical and geological exploration, begun in 1931, of this region of Germany is summarized. The first geophysical surveys were made with torsion balance and several resulted in the discovery of gravitational maxima and minima. Later surveys were by the seismic-refraction method supplemented by exploratory drilling and with electrical well logging. Simultaneously detailed geological investigations were carried on. The results are shown as geological maps and profiles.—*S. T. V.*

12241. Ramachandra Rao, M. B. Geophysical prospecting methods: Indian Jour. Meteorology and Geophysics, v. 1, no. 2, pp. 93–104, 1950.

The development of geophysical prospecting and fundamental principles of different geophysical methods are outlined. Geophysical prospecting in India since its beginning in 1923 is reviewed and the work of the Geophysical Section of the Indian Geological Survey is described. At present the Section is working on problems of mineral and petroleum exploration and on geophysical investigations connected with hydraulic engineering and water supplies.—*S. T. V.*

12242. Wadia, D. N. The aid of geophysics in mineral exploration in India: Indian Jour. Meteorology and Geophysics, v. 1, no. 1, pp. 15–16, 1950.

Because more than 750,000 square miles in India are covered by thick alluvial silts of the Indus-Ganges river system or by ancient lava flows, the absence of outcrops of ores makes the orthodox methods of prospecting inapplicable. Modern geophysical techniques, in spite of natural limitations, are thus very important in India.—*S. T. V.*

12243. Rodriguez Aguilar, Manuel. Los problemas de la exploración en México [Exploration problems in Mexico]: Asociación Mexicana Geologos Petroleros Bol., v. 2, no. 4, pp. 231–243, 1950.

A review by the president of the association of the problems and difficulties facing the geologist, the geophysicist, and the engineer in petroleum exploration in Mexico.—*S. T. V.*

GRAVIMETRIC METHODS

12244. Oñate Espinosa, Roberto. Estudios geofisicas en la cuenca de Veracruz Geophysical investigations in the Veracruz region]: Asociación Mexicana Geologos Petroleros Bol., v. 2, no. 4, pp. 291–297, 1950.

Petroleos Mexicanos made a general reconnaissance survey of Veracruz along the shore of the Gulf of Mexico between 18° and 21° north latitude, mostly by the gravimetric method. A small area around Ignacio de la Llave was surveyed by the seismic method also. A Mott-Smith gravimeter with the thermostatic control and a torsion balance were used in the gravity survey. The total number of stations occupied is not given. The results of the surveys are presented on five maps showing isogams, gravimetric anomalies, and seismic profiles.—*S. T. V.*

12245. Closs, Hans. Zum Schwerebild der Salzstrukturen Nordwestdeutschlands [On the gravity pattern over the salt domes of northwestern Germany]: Erdöl u. Tektonik in Nordwestdeutschland, pp. 293–299, 1949.

Up to 1945 some 150,000 gravity determinations with torsion balance and gravimeter were made in an area of 100,000 sq. km. in northwest Germany. Certain findings of the torsion balance measurements regarding salt domes are presented. Four types of salt domes were found among the 170 domes so far discovered. Eighty percent of these have relatively simple gravity curves with pronounced minima over the center of the dome, 9 percent have maxima over the core of the dome, the remaining 11 percent show gravitational minima, but with a more complicated curve. Eight typical gradient curves and seismic reflection profiles obtained in these explorations are reproduced and the structure of the corresponding domes analyzed. A map of the region shows locations of salt domes of the four types.—*S. T. V.*

12246. de Sitter, L. U., Editor. Eindverslag van het geophysische onderzoek in ZO-Nederland [Geophysical survey of the southeast Netherlands] [In Dutch with condensed English translation]: Mededeelingen van de Geologische Stichtung, Ser. C, v. 1, pt. 3, no. 1, 372 pp., 1949.

Gravity and magnetic surveys of southeastern Netherlands were made during the war by the Department of Geology of the University of Leyden to investigate structural conditions in Limburg and eastern and central Noordbrabant as a base for further exploration for coal, and to trace the large faults of southeastern Limburg with as much detail as possible. An isogam map of the area was constructed from observations at 3,634 torsion balance and 214 gravimeter stations. A flat minimum trends northwestward with a rather sharp rise on both sides. The magnetic survey was made with a vertical variometer, with 333 stations occupied. No obvious connection between the variations of vertical intensity and major structural features was found. The geology of the surveyed area is described in some detail. Contributors to this report include, besides de Sitter, F. Winkelaar, W. J. Van Riel, G. Zijlstra, and A. Maaskant.—*M. C. R.*

12247. Weng, W. P. The application of gravity exploration in Taiwan: Chinese Geophys. Soc. Jour., v. 1, no. 2, pp. 215–220, 1949.

Although the geological structure of Taiwan is favorable for oil and gas pools, before the war, more than 200 wells had been drilled on the island with only moderate success. An extended gravitational survey with more than

7,000 stations occupied was made in the western plain of Taiwan in 1946 in search of oil. Several promising locations were discovered.

In the Chin-Shui [Kinsui] gas field, where important gas sand deposits had been discovered at a depth of 600–700 meters, Bouguer anomalies of as much as 5 mgal. were found. Most of the producing wells lie closely to the gravity maximum. The gravitational data indicate a structural high at a greater depth than the known deposit of gas sand.

In the Chu-Tung [Chikutō] gas field, the map of gravity anomalies suggests the structure is a symmetrical anticline with the axis striking east-northeast and with two culminations separated by a saddle.

A third important anticline is the Tung-Shio [Tsūsho] anticline near the coast, partly covered by the alluvial deposits. A map of Bouguer anomalies of this region is also given. On the basis of gravitational data two culminations on the anticline proper can be expected.—*S. T. V.*

MAGNETIC METHODS

12248. de Andrade, Adalberto, Martins da Silva, João, Dos Reis Arrude, Carlos, and da Silva Gamerio, José. Minas de ferro de Montemór-o-Novo [Iron mines of Montemór-o-Novo]: Portugal Servico de fomento mineiro Relatoria, no. 15, 125 pp., 1949.

Magnetic surveys were made by the Aktiebologet Elektrisk Malmletning of Stockholm in connection with the exploitation of the iron ores south of Montemór-o-Novo. In general a good agreement was found between the results of the survey and the subsequent drilling. The total amount of deposits discovered to date is about 150,000 tons.—*S. T. V.*

12249. de Andrade, Adalberto. Breve noticia sobre a aplicacao do processo magnetico de prospeccao en algums dos jazigos de magnetite do Alentejo [Short notes on the use of the magnetic method in prospecting for magnetite ores in Alentejo]: Portugal Servico de fomento mineiro, Estudos, notas, e trabalhas, v. 5, no. 1–2, pp. 1–22, 1949.

This is a report on magnetic surveys in different parts of Alto Alentejo in search for magnetite ores, especially the exploration of the Montemór-o-Novo and Alvito deposits. The first survey was partly reported in the preceding abstract. A total of 9,190 stations in an area of 16.78 sq. km. were occupied during these surveys. The results are presented in the form of fifteen magnetic profiles, two maps of magnetic isoanomalies, and numerous cross sections.—*S. T. V.*

12250. Modriniak, N. Geophysical investigation of Rotorua: New Zealand Jour. Sci. Technology, v. 30, no. 1, pp. 1–19, 1948 (1949).

The magnetic properties of an area of approximately 16 sq. mi. northeast of the lake, Roto Rua, were investigated and the data analyzed for information of geological structures controlling the Roto Rua depression. The general trend of isoanomaly lines is believed to be the expression of an extensive sheet of northerly strike and westerly dip, probably produced by sinking of part of the ignimbrite sheet. Roto Rua occupies a drowned downwarp. The existence of a fault between Whakarewarewa and Ohinemutu [Roto Rua] is inferred and the extension of the sinuous Horohoro fault northward suggested. Experimental resistivity and spontaneous polarization measurements indicated valuable results might be obtained from more extensive observations.—*M. C. R.*

12251. Schonstedt, E. O. and Irons, H. R. Airborne magnetometer for measuring the earth's magnetic vector: Science, v. 110, no. 2858, pp. 377–378, 1949.

An airborne instrument that continuously records geomagnetic information from which all magnetic components may be determined has been developed by the Naval Ordnance Laboratory. The instrument measures the intensity and direction of total magnetic field vector with respect to a set of coordinate axes stabilized with respect to the surface of the earth. At present operation of the magnetometer is limited to areas of dip angles greater than about 50°, but additional developments now in progress may extend the range of operation.—*M. C. R.*

12252. Hurley, P. M., and Thompson, J. B. Airborne magnetometer and geological reconnaissance survey in northwestern Maine: Geol. Soc. America Bull., v. 61, no. 8, pp. 835–842, 1950.

An aeromagnetic survey of about 2,000 square miles in northwestern Maine was made to guide and assist reconnaissance geologic mapping of asbestos-bearing ultramafic rocks. Diagnostic magnetic patterns were found to be associated with the four principal geologic units: broad low gradient features over the Moose River sandstone, slate, and quartzite of middle Devonian age; linear anomalies over the slates, pyroclastics, flows, and ultramafic intrusives of Silurian and Devonian age; "bird's eye maple" over granites of late Devonian and pre-Silurian age; and "intricate and continuing convolutions" over areas of "older" gneiss. The report describes the geologic formations, in particular the Moose River, and is accompanied by a geologic map with fossil localities and superimposed magnetic total-intensity contours.—*J. R. B.*

12253. U. S. Geological Survey. Total intensity aeromagnetic maps of Indiana: Geophysical Investigations Maps GP20–GP34, Scale 1 inch=1 mile, contour interval=10 gammas, 1950.

A continuation of the series first listed in Abstract 11816. Maps of Adams, Allen, Carroll, De Kalb, Howard, Huntington, Kosciusko, Lagrange, Miami, Noble, Porter, Steuben, Wabash, Wells, and Whitley Counties, an area of 6,000 square miles in northern Indiana, have been prepared by W. J. Dempsey, J. R. Henderson, and R. T. Duffner.—*M. C. R.*

12254. U. S. Geological Survey. Total intensity aeromagnetic maps of Missouri. Geophysical Investigations Maps GP13 and GP14, Scale 2 inches=1 mile, contour interval=50 gammas, 1950.

A continuation of the series first listed in Geophys. Abstract 11818. Maps of Potosi and Bonne Terre quadrangles, an area of 500 square miles in the southeast Missouri lead district, have been prepared by W. J. Dempsey, R. T. Duffner, J. H. Henderson, and Fred Keller.—*M. C. R.*

12255. Gilmour, Andrew. The state of seismic prospecting: Geophysics, v. 15, no. 3, pp. 395–408, 1950 and Am. Assoc. Petroleum Geologists Bull., v. 34, no. 7, pp. 1384–1388, 1950.

This is the address of the retiring president of the Society of Exploration Geophysicists. The development of seismic prospecting is reviewed, and a plea is made for more adequately trained personnel so that the method may continue to advance.—*M. C. R.*

SEISMIC METHODS

12256. Nesbit R. H. The work of the geologist in civil engineering: Ohio State Univ., Eng. Exper. Sta. News, v. 22, no. 2, pp. 4–8, 23–25, 1950.

A brief review of the working relations between geologist and civil engineer is presented, with special emphasis on problems that arise in connection with dam construction where the shallow-refraction seismic method may be used. Several geologic cross sections with corresponding seismic profiles are included.—*S. T. V.*

12257. Lorenz, Hans. Stand des dynamischen Bodenuntersuchungsverfahrens [The present status of the dynamic ground exploration]: Abh. Bodenmechanik u. Grundbau 1939–1948, pp. 81–87, 1949.

The dynamic investigation of the ground for structural purposes consists of producing seismic waves in it by a special vibrator and studying their propagation in different directions. Observations of the time curve by geophones placed at varying distances from the point of the generation of the waves may provide reliable information on the geologic structure of the site.

A description of the vibrator for producing impulses in varying directions is given. A method is also described for placing the vibrator in a vertical drill hole at different depths and observing the produced seismic waves by a geophone placed in another hole.—*S. T. V.*

12258. Carome, E. F. An electronic vibration meter: Am. Geophys. Union Trans., v. 31, no. 4, pp. 529–530, 1950.

A completely portable electronic instrument for vibration measurement has been developed. The instrument is basically a pulse voltmeter and as such can be used with different types of transducers to measure peak displacement, velocity, or acceleration. As an accelerometer, it consists of three parts: an inertia-type pickup, an amplifier, and a pulse-recording circuit. The circuit is such that a meter responds to the maximum amplitude of a transient or continuous voltage input. This indication can be held for an indefinite time. The instrument has been used successfully for determining acceleration of vibrations caused by industrial machinery and blasting.—*M. C. R.*

12259. Buchheim, Wilhelm. Zum Problem der elektrischen Übertragung seismischer impulse über grossere Entfernungen mittels Kabel [The problem of electrical transmission of seismic impulses over great distances by cable]: Geofis. Pura e Appl., v. 16, fasc. 1–2, pp. 81–86, 1950.

The possible retardation of the recording and the distortion of the wave shape by the electrical transmission of seismic waves from remote seismometers to a central recording panel is studied, using the differential equation for an electrical wave spreading over a cable. The following four arrangements of the connecting wires are considered: an overhead line consisting of a double conductor with two millimeters between the wires; the same wires, 1 meter apart; a double conductor laid directly on the ground; a simple wire laid on the ground with the earth used as return line. In each case, the distance between the seismometer and the central recording panel is assumed to be 20 km., and frequencies of different waves assumed to range from 10 to 100 c.p.s. Phase velocities, damping constants, retardation intervals, and the percentage factors of wave distortion were computed. The damping constants can be as high as one percent per kilometer length of the cable, and retardation of the record in the conditions investigated may be about 1/150 second producing a noticeable distortion of the wave shape.—*S. T. V.*

12260. Berson, I. S. Interpretation of travel time curves of Mintrop's waves for a refracting boundary of arbitrary shape [in Russian]: Akad. Nauk SSSR Izv., Ser. geog. i geofiz., v. 13, no. 6, pp. 545–555, 1949.

The problem considered is the determination of the refracting boundary surface between two formations from a given three dimensional travel time curve of Mintrop's waves, when the velocity V_1 in the overburden is known as well as the velocity V_2 in every point of the refracting boundary. The travel time curve is referred to a chosen line S passing through the initial points. This determines uniquely the shape of the refracting boundary. A method is developed of finding from this given line, the corresponding curve L on the boundary surface. The line L may also be found from the travel time curve of the reflected waves.

The procedure for determining the refracting boundary may be made relatively simple if tangential planes touching the boundary at a series of consecutive points are first determined. Analytically the problem is reduced to the integration of a system of ordinary differential equations of the first order. The integration may be made either by the approximate method of Sterner or Euler's procedure. The initial conditions vary from point to point of line L. The values of functions entering into these equations can be found either by numerical computations or graphically. The integral determines a family of characteristics, passing through every chosen point of line L. The envelope of these characteristics forms the boundary surface.

Any desired degree of precision can be achieved. For the limiting case with Δa 0 the most accurate solution is obtained. In practice, there is no good reason to strive for a high degree of accuracy because variations of the velocities V_1 and V_2 are known only approximately.

The same method may be used in interpreting a series of travel time curves for a stratified medium if the velocities in individual layers are given as well as the velocities along the boundary surface between the layers.—*S. T. V.*

12261. Krey, Theodore. Die Berucksichtigung der Brechung in der Reflexionsseismik [Influence of refraction phenomena in seismic prospecting by the reflection method]: Erdöl u. Kohle, 2d Jahrg., Heft 7, pp. 273–277, 1949.

In interpreting observations made by seismic reflection method, the refraction of seismic rays is generally neglected and the rays are assumed rectilinear. Such simplification is frequently inadmissible and results in an inaccurate or even erroneous location of the reflecting horizon. An approximate method is presented, taking into account the refraction of seismic rays. Corrections are given (but not derived) for the angle of the arrival of reflected rays and for the coordinates of the base of the perpendicular to the reflecting horizon from the shot point. The iteration procedure is recommended as giving good results even in difficult geological conditions. Several examples illustrate the suggested procedure.—*S. T. V.*

12262. Quarles, Milton, Jr. Fault interpretation from seismic data in southwest Texas: Geophysics, v. 15, no. 3, pp. 462–476, 1950.

Many of the oil-bearing structures around the Gulf Coast and in southwest Texas are found along normal faults which are characterized by the shallow dip of fault planes, "reverse-drag" appearance of dips on each side of the fault, and the rapid dying out of movement both vertically and horizontally. Reflection shooting across these faults gives normal information on the downthrown side but produces distorted and misleading data below the fault plane on the upthrown side. In one type of distortion, as the fault is approached on the upthrown side, the first distorted profiles under the fault have recognizable reflections with a lag of several feet, as much as 100 milliseconds, from the same reflections on the adjacent normal profile. This "drop" type of distortion is explained by a refraction pattern downward along a portion of the fault plane before the energy is reflected back from the recognized interface. If this time lag is not recognized, the fault may be located as much as a mile from its true position.

In the second type of distortion, the deeper beds appear to dip down at a steeper than normal angle toward the fault plane. Distortion of this kind appears to be associated with faults with throws of 50 to 300 feet. This "increased-dip" type of distortion may be explained either as a reflection time lag through the gouge zone of the fault or a refraction across the fault plane and a reflection from the known interface. The magnitude of this effect may be great enough to cause some reflecting horizons on the upthrown side of the fault to be plotted deeper than those on the downthrown side. It can easily cause errors in locating the fault and determining the magnitude and direction of throw, or may cause the fault to be completely missed.—*M. C. R.*

12263. Lorenz, Hans. Anwendung des seismischen Bodenuntersuchungsverfahrens bei einem Talsperrenbau [The use of the seismic exploration method during dam construction]: Bautechnik-Archiv, Heft 3, pp. 40–48, 1949.

Before the construction of the Bicaz dam across the Bystřice in the eastern Carpathian Mountains, an extensive seismic refraction survey was made. The article contains a brief review of the method and a description of the apparatus used (such as electric seismographs, oscillograph, recording attachment), and includes a table of the velocities of propagation of seismic waves in different formations in the surveyed area. The underlying formation is a thick layer of sandstone covered with conglomerate of varying thickness, but not less than 10 meters. Approximately 105 determinations were made, some at points in the river bed. The results of seismic surveying were checked by six exploratory drill holes, and excellent agreement between these data was found.—*S. T. V.*

12264. Cantos Figuerola, José. Comprobación por sondeo mecánico de una prospección sismica en Miajadas [Confirmation by exploratory drilling of seismic prospecting results in Miajadas]: Rev. Geofís., v. 9, no. 33, pp. 79–87, 1950.

During the spring of 1947 a seismic refraction survey was made in the environs of Miajadas, Spain, in search for water resources. Thirty profiles of a total length of 25 km., with 358 geophone locations, were obtained. The depth of water-impermeable horizon (granite) was evaluated in 15 profiles. By drilling on two profiles which presented more favorable indications for water reservoirs, the depth to granite was found to be 216 and 150 meters where the seismic determinations had been 208 and 168 meters. These differences may be decreased in future surveys by the changes in the assumptions as to the velocity of wave propagation in the ground.—*S. T. V.*

12265. Müller-Deile, G. Reflexions seismische Messungen im Wattenmeer bei Cuxhaven [Seismic reflection measurements on the sandbanks near Cuxhaven]: Erdöl u. Kohle, Jahrg. 3, Heft 5, pp. 214–216, 1950.

A short description is given of seismic work over sandbanks between Cuxhaven and Spieka on the North Sea in a region regularly covered with water during high tide. Only a short interval of time during the ebb was available for the measurements. Results of the seismic surveying are compared with the data obtained from seven exploratory drillings. Two profiles to depths of more than 2,000 meters show the geological interpretation.—*S. T. V.*

12266. Ramspeck, Adolf, and Schulze, G. A. Schwingungsuntersuchungen an einfachen Mauerwerkskorpern und Gebauden [Vibration studies on simple masonry bodies and buildings]: Bautechnik-Archiv, Heft 3, pp. 66–72, 1949.

Several pieces of masonry walls of different dimensions and composition were tested to determine the critical frequencies if exposed to seismic vibrations. Vibrations of the ground were produced by a mechanical vibrator, running with different speeds, set on the ground at a certain distance from test specimens, and vibrations of these specimens were measured by seismometers. A sharp change of the amplitudes was observed at a certain frequency characteristic for the dimensions and mechanical properties of individual specimens. In another series of experiments vibrations of the ground were again produced by a vibrator and the resulting vibrations were observed and measured at different heights in a three-story building nearby. By running the vibrator with different speeds, it was possible to determine the critical frequency of the building. Knowledge of critical frequency of a structure is of great importance in evaluating the seismic danger to which it would be exposed at the time of an earthquake.—*S. T. V.*

ELECTRICAL METHODS

12267. Fritsch, Volker. Grundzüge der angewandten Geoelektrik [Principles of the electrical methods in applied geophysics], Vienna, Manzche Verlags u. Univ. Buchhandlung, 412 pp., 1949.

This is a treatise on the electrical methods and procedures in applied geophysics. Among the subjects discussed are the electrical properties of rocks and aggregates, measurements by methods using direct current, and alternating current of low and moderate frequency, and also high-frequency-radio methods. Practical examples of investigations of geological structures, of prospecting methods in hydrological work, geophysical exploration of the ground for foundations of structures, exploration of ore deposits, prospecting for oil, and for potassium are described. An extended bibliography is included.—*S. T. V.*

12268. Paul, Bernt. Geoelektrische Schlumberger Messungen an der Erdoberfläche und in Bohrloch [Geoelectrical measurements by the Schlumberger method on the surface of the ground and in drill holes]: Erdöl und Tektonik in Nordwestdeutschland, pp. 302–307, 1949.

Most commonly used electrical exploration methods are the four or five point-resistivity measurements and self-potential determinations. With the exception of a few ores, dry rocks are practically nonconductive, and only their water content makes them conductors. Differences in mineral substances dissolved in this water, and variations in porosity, surrounding temperature and other factors cause variation of measured electrical resistivity of the same rock, making electrical resistivity a doubtful indicator in prospecting. Only by combining resistivity data with other geophysical and geological information is it possible to interpret the findings of an electrical survey.

Examples of practical cases of prospecting by two electrical procedures and interpretation of the results are discussed. The curve of resistivity variation over a salt dome is also discussed, and a profile obtained from measurements of earth currents is compared with one from a seismic reflection survey.—*S. T. V.*

12269. Gilchrist, Lachlan, Clark, A. R., and Bernholtz, Ben. Methods of determination of the average resistivity of a two-layered medium: Canadian Min. Jour., v. 71, no. 1, pp. 55–64, 1950.

Geoelectric methods used for the location of anomalies in a homogeneous medium are reviewed. The proper experimental procedures are outlined with emphasis placed on equality of stake resistances at the current electrodes. It is pointed out that unequal stake resistances give rise to spurious effects which may mask the true anomalies. To avoid this a field method is presented for the measurement and equalization of stake resistances. The formulas and some of the methods used in interpreting are discussed for both point and line electrodes placed either within or on the surface of the earth. Several illustrations are given showing the applicability and usefulness of the various methods.—*I. Z.*

12270. Enenstein, B. S. Results of field experiments on the building up of the electrical field in the ground [in Russian]: Akad. Nauk SSSR, Doklady, v. 67, no. 1, pp. 57–59, 1949.

The process of building up of the electrical field in the ground under the action of an electrical impulse has been investigated experimentally with special attention to the period of transient conditions. An impulse of rectangular wave shape, produced by a thyratron generator, was sent through a feeding dipole into the ground and the potential difference produced by the impulse was measured at different distances from the feeder by a cathode-ray oscillograph provided with photographic recording attachment. Good agreement was found between measured values and those computed from Tikhonov's formula $t = \pi x^2/10^3 r$, where t=time necessary for the field intensity at a point x meters distant from the dipole to reach 0.78 of its final value, and r is the specific electric resistance of the ground. Differences in the experimental determination caused by atmospheric phenomena, radio interference, and other causes were overcome by a complicated arrangement not described in this paper.—*S. T. V.*

12271. Tikhonov, A. N. On the transient of an electric pulse in an unhomogeneous stratified semispace [in Russian]: Acad. Nauk SSSR Izv., Ser. geog. i geofiz., v. 14, no. 3, pp. 199–222, 1950.

The previous study of the transient of an electrical pulse in a homogeneous conductive semispace (*see* Geophys. Abstract 9235) is extended to the case of unhomogeneous stratified semispace. It is assumed that a cable, grounded at both ends, is laid on the surface of a conductive semispace (earth), and at a certain moment electric current of an intensity I (t),variable with time, is switched into the cable, the initial value of the current being given. The process of the distribution of the current in different points of space, varying with time is studied, especially during the transient period.

The method of solution consists in determination of the electric and magnetic vectors, satisfying Maxwell equations under the conditions of the problem. The magnetic field has the property that the circulation around the current line over an infinitesimal contour is determined by the expression $(4\pi/C)I$ where C indicates the use of electronic units. Electric conductivity varies from one layer to the next, but remains constant within the layer.

The solution is given in a general form, numerical results corresponding to different specific cases are to be published later.—*S. T. V.*

12272. Buchheim, Wilhelm. Über ein neuartiges Prinzip der elektrischen Tiefensondierung [A new principle of electrical deep sounding]: Geofis. Pura e Appl., v. 16, fasc. 1–2, pp. 76–80, 1950.

A new method of electrical exploration, based on the theoretical studies of R. M. Foster and S. S. Stefanescu, may be especially useful in deep sounding or in exploration of stratified ground. In the proposed procedure a constant separation of the current and potential electrodes is used and the frequency of the feeding current is varied. It is possible with a 1,000-meter spread of the electrodes to study strata as deep as about 500 meters. A great saving of time is effected by elimination of the fastidious job of electrode grounding and the effects of polarization do not interfere with the measurements. However, a technical difficulty exists in the necessity of varying the frequency from a few cycles per second to 500 or even 2,400 according to the depth to be reached.—*S. T. V.*

12273. Crumrine, K. C. A method of electrical profiling: Geophysics, v. 15, no. 3, pp. 477–482, 1950.

The mutual resistances pertaining to 22 electrode patterns may be obtained by making three sets of measurements at each station, using three patterns with fixed electrode spacing along the profiles. "Mutual resistance" is defined as the ratio of the potential difference between the two potential electrodes to the energizing current, when direct current or low-frequency alternating current is used. The 22 electrode patterns and their corresponding apparent resistivity equations are tabulated, together with equations for mutual resistances for 19 electrode patterns, expressed in terms of the three observed mutual resistances.—*H. R. J.*

12274. Müller, Max. Die Drehkreuzmethode [The method of rotating electrodes placed crosswise.]: Geofis. Pura e Appl., v. 16, fasc. 1–2, pp. 47–75, 1950.

Continuous current is sent into the ground through two feeding electrodes and the generated field is measured on the surface of the earth by two potential electrodes, placed either on a line perpendicular to the line of feeding electrodes or at a certain angle to it. The distance from the midpoint to the symmetrically placed measuring electrodes may be varied. The pattern of the electrical field generated in a homogeneous ground by the feeding electrodes is known, and that for spherical and ellipsoidal disturbing bodies in different positions underground with reference to the feeding electrodes is computed.

By comparing the master charts with the results obtained from a survey of a region, the position of the disturbing bodies may be determined approximately.

With certain modifications the new arrangement can be used as induction method with two coils perpendicular to one another, supplied by low-frequency current.—*S. T. V.*

12275. Maher, J. C., and Jones, P. H. Ground-water exploration in the Natchitoches area, Louisiana: U. S. Geol. Survey Water-Supply Paper 968–D, pp. 159–211, 1949.

As part of an exploratory program to locate an adequate water supply for the city of Natchitoches, La., electric logs were made of nine exploratory wells which penetrated the Sparta sands and the water sand of the Wilcox formation. These consisted of both self-potential and apparent-resistivity curves, the latter obtained for different electrode spacings. Fresh-water sands were indicated by sharp deflections of the resistivity curves to the right and more moderate deflections of the self-potential curve either to the left or to the right, away from the shale base. A detailed geological description of the area is included.—*S. T. V.*

12276. Bureau des Recherches géologiques et géophysiques. Prospection électrotellurique de la Bresse et du Bas-Dauphiné Pub. 5, 47 pp. 1948.

Detailed descriptions are given of the electrotelluric survey in Bresse and Bas-Dauphiné. The surveys in Bas-Dauphiné were among the first by the telluric method, and the experience gained in Bas-Dauphiné and Bresse has contributed greatly to the methods. In addition, a number of soundings along short profiles were made in known territory to determine the characteristic resistivities as an aid in the geological interpretation. Three maps of northern and southern Bresse and of Bas-Dauphiné show by various colors the intensities of the telluric current.—*M. C. R.*

12277. Goguel, Jean. Essai d'interprétation de la prospection géophysique de la Bresse et du Bas-Dauphiné: Bur. Recherches géol. et géophys. Pub. 6, 79 pp., 1948.

A rather detailed geologic interpretation of the gravimetric and electrical surveys in Bresse and Bas-Dauphiné is made, and from this conclusions are drawn about the relations of the Alps and Jura Mountains. The principal conclusions were reported in Geophys. Abstract 11355.—*M. C. R.*

RADIOACTIVE METHODS

12278. Pringle, R. W. A portable scintillation spectrometer: Atomics, v. 1, pp. 49–50, 1950.

The construction and operation of a portable scintillation spectrometer which may attain a sensitivity of 10^{-10} r./sec. is described. The instrument uses single, activated alkali halide crystals in conjunction with an RCA 5809 wide-angle photomultiplier tube.—*M. C. R.*

12279. Bateman, J. D. Prospecting with the Geiger counter: Canadian Inst. Min. Metallurgy Trans., v. 72, pp. 111–116, 1949.

The Geiger-Müller counter and its use in prospecting for radioactive ores is described. Field experience has shown that 1 to 2 feet of solid rock, 3 to 5 feet of unweathered compact overburden, or a somewhat greater depth of loose soil may effectively shield even important pitchblende occurrences from detection with the counter. As the intensity of the emanations varies inversely as the square of the distance from the source, deposits may remain undetected by the portable counter at distances of 30 to 40 feet. Counter tubes for which the normal cosmic ray background count is of the order 30 to 40 impulses per minute are most satisfactory for counting by earphone.—*S. T. V.*

12280. Goldin, A. S., Rohrer, E. R., and Maclen, R. L. Scintillation type alpha-particle detector: Rev. Sci. Instruments, v. 21, no 6, pp. 554–557, 1950.

A portable scintillation detector for alpha-survey work, specially designed for low-intensity measurements, may be adapted for field use. The instrument can detect as few as 16 alpha counts (32 disintegrations) per minute, being practically free of spurious background; its upper limit is over 48,000 counts per minute and can be raised still higher. The instrument is strong and is unaffected by most atmospheric conditions other than strong sunlight. Gamma radiation up to 14,000 milliroentgens per hour does not give detectable response on this alpha meter. A description of the instrument and a wiring diagram are given—*S. T. V.*

12281. Stead, F. W. Equipment for uranium prospecting: Electrical Eng., v. 69, no. 3, p. 254, 1950.

Equipment and methods of uranium prospecting now in use by the U. S. Geological Survey are described. Included are surface prospecting with portable Geiger counters, subsurface prospecting by gamma-ray logging of exploratory drill holes, and airborne prospecting, using anticoincidence counting-rate meters and air-conductivity meters to detect radiation.—*S. T. V.*

12282. Stead, F. W. Airborne radioactivity surveying speeds uranium prospecting: Eng. and Min. Jour., v. 151, no. 9, pp. 74–77, 1950.

U. S. Geological Survey equipment and techniques of radioactivity surveying are described. Instruments consist of a radiation detector of 19 Geiger counters connected to an anticoincidence counting-rate meter and an air-conductivity meter. All measurements are made at approximately 500 feet above the ground and flight traverses are spaced at quarter-mile intervals. Anomalies must be defined on a statistical basis, and can be interpreted to mean only that the locality represented is more radioactive than the surrounding area.—*M. C. R.*

WELL LOGGING

12283. Ziloff, Wladimir. Établissement et interprétation des diagrammes d'investigation continue des sondes en vue de leur completement [Obtaining of continuous logs and their interpretation in view of the completion of exploratory drill holes]: Inst. Franç. petrole Rev., v. 4, no. 10, pp. 566–575 and no. 11, pp. 608–614, 1949.

Methods of obtaining continuous information on the nature of formations traversed by a drill hole include examination of the cuttings brought to the surface by circulating mud, preparation of drilling-time logs, and mud analysis. The first gives information on lithological properties. For this purpose the pumped mud is at definite time intervals driven through several containers where the suspended rock particles are caught by the system of screens of different fineness. The drawback is that particles of different size do not arrive at the top of the hole simultaneously but undergo some differentiation. A table of time delay as a function of particle size is given. The particles obtained from the screens are studied for their mineralogical composition and are chemically analyzed for their hydrocarbon content. An apparatus for continuous registration of this content is described. An increase of the hydrocarbons in the cuttings is an indication of the proximity of a producing horizon. An important empirical rule states that the increase of higher homologues, without a simultaneous increase of the methane content, is an indication of a poor reservoir.

The drilling speed is in certain limits inversely proportional to the hardness of the rock and this is in turn a function of its porosity. Parallel microscopic examination of samples will show when a greater softness of the rock is caused by the presence of gypsum or calcite. A table of the speed of drilling as a function of porosity is given, and several instruments for measuring and recording this speed are described.—*S. T. V.*

12284. Doll, H. G. The S. P. log: Theoretical analysis and principles of interpretation: Am. Inst. Min. Met. Eng. Trans., v. 179, pp. 146–186, 1949. (Also issued as TP 2563 in Petroleum Technology, September 1948.)

A theory of the S. P. or spontaneous potential log which may serve as a guide for interpretation and a foundation for future discussion is presented. The log is shown to be a measurement of the potential drop along the drill hole caused by ohmic effect in mud. The e.m.f. generating the S. P. current which affects the S. P. log arise from two types of phenomena: electrokinetic, producing an e.m.f. of filtration at the contact between drilling mud and permeable bed; and electrochemical at the contact of media of different natures. The shape and amplitude of peaks may be influenced by the total e.m.f. involved; the thickness of the bed; resistivity of the bed, surrounding formations, or mud; the diameter of the drill hole; or the depth of penetration of mud filtrate in permeable beds.

The log is essentially a good detector of permeable beds, but it does not measure the value of the permeability or porosity. Several simple rules are given for better distinction of the boundaries of permeable sections.—*M. C. R.*

12285. Roberts, A. Portable Geiger counter for drill holes: Radio Electronic Eng., v. 13, pp. 16–17, 21, 28, 1949.

A portable, battery-powered Geiger-Müller counter mounted on the end of a 1,000-foot cable which can be lowered down in 1¼-inch borehole is described. The tube is a single-ended self-quenching type. The tube signal is amplified 2,500 times in 2 stages.—*M. C. R.*

12286. Bush, R. E. Porosities can be obtained from radioactivity logs in West Texas. Examples of quantitative technique shown for Scurry County: Oil and Gas Jour., v. 48, no. 51, pp. 153–165, 1950.

A radioactivity log may be used to determine porosity in a given area by selecting a cored well which has been logged by radioactivity logging devices as a base well from which a neutron-derived porosity curve and a gamma-ray subtractive curve may be determined. These curves may then be applied, after allowance for log sensitivity, to wells with the same bore-hole diameter and casing program. For wells with a different bore diameter or casing program, other base determinations must be made to satisfy all conditions existing in the field. Several examples are given of quantitative interpretations of radioactivity logs of wells in Scurry County, Tex. A neutron-derived porosity curve is shown which is applicable to the radioactivity logs of other 6¼-inch uncased wells in the area.—*M. C. R.*

12287. Andrée, H. Neues diagramm zur Berechnung der Durchlassigkeit von Speichergesteinen aus Laboratoriumsmessungen [A new diagram for computation of the permeability of reservoir rocks from laboratory measurements]: Erdöl u. Tektonik in Nordwestdeutschland, pp. 314–321, 1949.

Among the tests usually made on lithological samples in well logging, determinations of porosity saturation and in the first line of permeability are the most important. To facilitate the experimental procedure and to eliminate tedious calculations in determinations of permeability following the procedure and standards established in 1935 by the American Petroleum Institute, a graphical method is suggested. The new procedure, with auxiliary tables and four alinement charts, represents a great saving in time. The accuracy of the proposed method is satisfactory for practical purposes, the errors seldom being greater than ±5 percent. The suggested method of permeability computation is applicable to fluid flow of any intensity and under any pressure. Several examples of the use of these charts are worked out.—*S. T. V.*

12288. Schumann, H. Die Raumgestaltung von Gesteinsporen [The spatial variation of the form of pores in rocks]: Erdöl u. Tektonik in Nordwestdeutschland, pp. 321–325, 1949.

The porosity of rocks determines their capacity of retaining water or oil; the form of the pores and their interconnection determines the permeability of formations. Experimental determination of the porosity of a sample is not difficult, but the influence of the form of pores on the permeability is a different and a more complex question. As an example, specimens of glauconite were tested for porosity and permeability, and it was found that test pieces of the same percentage of porosity may show great differences in permeability. In many of the specimens tested, permeability decreased because of the presence of $CaCO_3$ in the mineral in the narrowest cross sections of the pores. The details of the experimental procedure for the determination of the porosity and of the form of the pores are discussed, and also a tentative numerical analysis of these two properties of a mineral.—*S. T. V.*

TECHNICAL AIDS

12289. Honnell, P. M. The application of feedback to an electromechanical transducer for seismograph testing: Seismol. Soc. America Bull., v. 40, no. 3, pp. 217–231, 1950.

Feedback may be used to provide substantially constant amplitude, velocity, or acceleration response from electromechanical transducers for seismograph testing, independent of loading effects. Careful control of residual parameters is needed to prevent undesired sustained oscillations of the platform. Although the improvement in response characteristics results in reduced platform velocities for a given control voltage, this is not serious as the available control voltage from most oscillators is usually ample. For nonsinusoidal wave shapes with abrupt discontinuities, such as square waves, there is no practicable substitute for feedback.—*M. C. R.*

12290. Selenyi, P. Galvanometers with photoelectric feedback: Hungarica Acta physica, v. 1, no. 6, pp. 1–8, 1949.

The functioning of a galvanometer provided with a photoelectric feedback is analyzed and suggestions are made for increasing the sensitivity without simultaneously influencing unfavorably other properties of the apparatus. This can be attained by feeding back currents which are proportional to the first and the second derivatives of the deflection with respect to time. In the differential equation of motion of the galvanometer, these coefficients are respectively the moment of inertia of the moving coil and the moment of damping forces.— *S. T. V.*

12291. Bardeen, Thomas. Crystal shake table for geophone studies: Geophysics, v. 15, no. 3, pp. 456–461, 1950.

Because conventional shake tables are unsuitable for testing geophones, a study was made to determine the possibilities of using piezoelectric crystals as a transducer to convert electrical voltage into mechanical motion. The study showed that a shake table could be built which would be small, give accurate reproduction of voltage for motions as small as 10^{-8} inches, require very little power, and be simple to calibrate. Construction of such a shake table using ammonium-dihydrogen phosphate as the piezoelectric material is described. The theory of geophone motion shows that measurements of the phase shift between the geophone output and the crystal shake table driving voltage can be used to determine the natural frequency and damping of the moving mass of the geophone.—*M. C. R.*

PATENTS

GRAVITY METHODS

12292. Gravimeter. Reginald C. Sweet, Houston, Tex., assignor to North American Geophysical Co., Houston, Tex., a corporation of Texas: U. S. patent 2,523,075, issued Sept. 19, 1950.

In a gravimeter a gravity-responsive member and an elastic system supporting said member in equilibrium with gravity in such manner as to provide for rotation of the member about a floating horizontal axis, said elastic system being connected to said gravity-responsive member so as to exert a force thereon having both vertical and horizontal components, means for shifting substantially vertically the position of the axis of rotation of the gravity-responsive member a determinable amount to null the instrument said means having a part readily available exteriorly of the gravimeter to facilitate nulling of the instrument. Claims allowed, 10.

MAGNETIC METHODS

12293. Method and apparatus for measuring magnetic fields. Ralph D. Wyckoff, Pittsburgh, Pa., assignor to Gulf Research & Development Co., Pittsburgh, Pa., a corporation of Delaware: U. S. patent 2,518,513, issued Aug. 15, 1950.

In a magnetometer comprising a supporting frame with outer and inner gimbals in which is mounted a gyro and three mutually perpendicular magnetic-detecting elements fixed with respect to the gyro, means controlled by two of the magnetic-detecting elements to precess the gyro into a plane having a fixed relation with respect to the earth's magnetic field, and means for indicating the output of the third magnetic-detecting element; the improvement which comprises a partial spherical shell having a rough outer surface and fixed with respect to the gyro axis so that a diameter of said shell lies on the inner gimbal axis, a pair of oppositely directed air jets on said supporting frame whose air impinges on said shell to respectively generate oppositely directed torques about the inner gimbal axis, an impeller mounted on the outer gimbal axis, a pair of oppositely directed air jets on said supporting frame whose air impinges on said impeller to respectively generate oppositely directed torques about the outer gimbal axis, and electrically actuated valves controlled by the said two precession-controlling magnetic-detecting elements to respectively control the air flowing through said jets to cause precession of the gyro into the desired orientation. Claims allowed, 4.

12294. Apparatus for detecting magnetic disturbances. Theodore Zuschlag, West Englewood, N. J., assignor by mesne assignments, to Lundberg Explorations Ltd., Toronto, Ontario, Canada, a corporation of Ontario: **U. S. patent 2,519,094, issued Aug. 15, 1950.**

Apparatus of the character described comprising, a plurality of spaced rotatable coils, means for rotating the coils in unison, transformers having their primaries connected to the coils and mounted to rotate therewith, stationary secondaries for said transformers connected in series opposition, a potentiometer, a variometer connected with the potentiometer, means for connecting the outputs of the transformer secondaries to the potentiometer and variometer, an amplifier, means for connecting the potentiometer and the variometer to the amplifier, and means for detecting any differential in the said amplified outputs. Claims allowed, 3.

12295. Magnetic gradient measurement. Robert E. Fearon, Tulsa, Okla., assignor to Stanolind Oil and Gas Co., Tulsa, Okla., a corporation of Delaware: U. S. patent 2,520,677, issued Aug. 29, 1950.

The method of measuring the gradient of a magnetic field which comprises disposing at a first spacing in said field a pair of substantially identical, magnetizable, ferromagnetic members, simultaneously and equally exposing each of said members to alternating magnetizing forces of two different unrelated frequencies, deriving from the resultant flux in each of said members electric waves containing sum and difference modulation frequencies of said two frequencies, subtracting from said electric waves produced at one of said members the corresponding electric waves produced at the other of said members, producing a first indication of the amplitude of the difference of said waves of one of said modulation frequencies, repeating the foregoing steps at a second spacing of said members whereby a second indication is produced, and determining the quotient of the difference between said first and said second indications by the difference between said first and second spacings. Claims allowed, 13.

SEISMIC METHODS

12296. Seismic exploration by means of periodic excitation. Serge A. Scherbatskoy, Tulsa, Okla., U. S. patent 2,521,130, issued Sept. 5, 1950.

Method of subsurface seismic surveying which comprises generating a periodic disturbance in the earth and varying the frequency of said disturbance in accordance with a predetermined function, receiving the resultant seismic waves travelling through the earth at a point removed from the source of said disturbance, transforming said received seismic waves into corresponding electrical currents, selectively receiving said currents and varying the selectivity of said reception simultaneously with the variation of the frequency of said disturbance, the variation of selectivity of said reception being effected in accordance with said predetermined function, and recording said selectivity received waves. Claims allowed, 8.

12297. Seismic wave transmitter. Robert S. Dahlberg, Jr., Caracas, Venezuela, assignor to Standard Oil Development Co., a corporation of Delaware: U. S. patent 2,522,433, issued Sept. 12, 1950.

Improved apparatus for introducing seismic energy into the earth at a selected point adjacent a fluid-filled borehole, comprising a cylindrical magnet provided with a central bore and an annular channel, a driving rod positioned longitudinally within said central bore, a coil positioned within said annular channel and provided with means mechanically connecting said coil with said driving rod, a mass element attached to said driving rod, flexible diaphragms attached to said rod and fastened to each end of said magnet in a manner providing for alignment of said driving rod within said central bore, said diaphragms defining with said central bore and said annular channel an oil-tight chamber, a reservoir for oil positioned adjacent the magnet and communicating with said chamber, and means associated with said reservoir adapted to maintain a pressure balance between oil placed in said reservoir and fluid in said borehole. Claims allowed, 3.

ELECTRICAL METHODS

12298. Einrichtung zur geophysikalischen Erforschung [Arrangement for geophysical exploration]. H. T. F. Lundberg, Toronto, Canada, and Theodore Zuschlag, West Englewood, U. S. A.: Austrian patent 166,400, issued July 25, 1950.

The invention relates to an arrangement for geophysical exploration, consisting of one or several electrical or magnetic sounding instruments which during the motion or when standing still could indicate the presence of anomalies in the ground, attributable to deposits of ores or petroleum. The arrangement is carried on a movable carrier, preferably an aircraft or a vessel, adapted also for transport of the attendants and equipment with a suspension for the instruments serving for stabilization of these instruments notwithstanding the movements of the movable carrier. Recording attachments are also installed on the carrier, acted upon by the sounding instrument or several of them and registering the action of the detected anomalies. Claims allowed, 9.—*S. T. V.*

RADIOACTIVE METHODS

12299. Radioactivity detector. Gilbert J. Perlow, John D. Shipman, Jr., and Clarence A. Schroeder, Washington, D. C.: U. S. patent 2,513,356, issued July 4, 1950.

A gamma-radiation detector, comprising a first radioactive-counter means, a second radioactive-counter means surrounding the first providing no substantial opposition to the passage of gamma-ray energy to the first counter means, and output means connected to the first and second counter means combining in opposition the output signals from said first and second counter means. Claims allowed, 8.

12300. Detecting device. William Rudolph Kanne, Chicago, Ill., assignor to the United States of America as represented by the U. S. Atomic Energy Comm.: U. S. patent 2,513,805, issued July 4, 1950.

In an instrument for detecting radioactivity, the combination of a plurality of fluorescent screens facing in different directions and at least one absorber associated with the exterior surface of one of said screens and partially shielding the screen with which it is associated. Claims allowed, 5.

12301. Radiation detector. Hugh G. Neil, Knoxville, Tenn., assignor, by mesne assignments, to the United States of America as represented by the U. S. Atomic Energy Comm.: U. S. patent 2,514,135, issued July 4, 1950.

A system of the character described for detecting radiation comprising means responsive to the radiation for producing electrical impulses corresponding in magnitude and configuration to the radiation, a circuit fed by the radiation responsive means for producing signals which discriminate in favor of the higher frequencies, means for amplifying and reproducing the signals, and an attenuator responsive to the signals for offering progressively greater attenuation to the lower frequencies. Claims allowed, 11.

12302. Radiation measurement and instrument testing. Jacob Neufeld, Oak Ridge, Tenn.: U. S. patent 2,516,334, issued July 25, 1950.

In an arrangement for testing the performance of a radiation counter by exposing said counter to a stream of radiation particles emitted at random, said counter translating the incoming particles into current impulses, an electrical network connected to said counter for producing a fluctuating current representing at any instant the rate of occurrence of said impulses, another network responsive to the output of said first network for producing a signal related to all the values of said current within a selected time interval, and a means jointly responsive to the outputs of said two networks for producing an indication representing a relation between said two outputs. Claims allowed, 8.

12303. Apparatus for measuring radiant energy. Frank G. Brockman, Dobbs Ferry, N. Y., assignor to Socony-Vacuum Oil Co., Inc., a corporation of New York: U. S. patent 2,516,672, issued July 25, 1950.

A bolometer comprising in combination a sealed housing, a metallic filament having uniform physical properties including cross-sectional area and electrical resistance and a substantial temperature coefficient of resistance in said housing, a pair of electrical conductors extending from a point outside the housing into the housing and forming electrical contacts with and supports for the respective ends of the filament, a third electrical conductor extending from a point outside the housing into the housing and forming electrical contact with and a support for the center of said filament, said housing shielding one section of said filament from radiation and having a window adjacent one section of said filament, whereby only one section of the filament can be subjected to radiant energy. Claims allowed, 3.

12304. Scintillation type radiation detector and coincidence circuit therefor. George A. Morton, Princeton, N. J., assignor to Radio Corp. of America, a corporation of Delaware: U. S. patent 2,517,404, issued Aug. 1, 1950.

In an electronic apparatus including a pair of electronic energy-responsive devices, a plurality of nonlinear resistive conductors, a pair of electron amplifiers and a third electronic energy-responsive device, the method of energizing the said third responsive device only when said pair of devices are energized simultaneously comprising: dividing the outputs of said pair of amplifiers, passing one each of said divided outputs through respective nonlinear resistive conductors, combining the others of said divided outputs in opposite polarity to said first-mentioned outputs, and passing the combined other outputs thereof through a third nonlinear resistive conductor, combining the outputs of said conductors into a coincidence output and applying said coincidence output to said third responsive device. Claims allowed, 14.

12305. Method and apparatus for measuring Alpha-particle radiation. Richard W. Dodson, Pasadena, Calif., and William H. Beamer, Youngstown, Ohio, assignors to the United States of America as represented by the U. S. Atomic Energy Comm.: U. S. patent 2,517,469, issued Aug. 1, 1950.

In apparatus of the class described, a gas tight closure which contains a quantity of a gaseous material which will react with alpha particles to provide neutrons, means for supporting an alpha-particle source within said closure, a body of neutron-slowing material disposed about said closure, said body containing a plurality of cavities located at differing distances from said closure, and neutron-detection means disposed within at least some of said cavities. Claims allowed, 6.

12306. Radiation counter. Volney C. Wilson, Schenectady, N. Y., assignor to the United States of America as represented by the U. S. Atomic Energy Comm.: U. S. patent 2,519,007, issued Aug. 15, 1950.

A fast neutron counter comprising spaced electrodes and a plurality of hydrogenous wafers dividing the space between said electrodes into a plurality of ionization regions. Claims allowed, 12.

12307. Method of measuring extent of oil saturation of porous materials. Paul P. Reichertz, Dallas, Tex., assignor, by mesne assignments, to Socony-Vacuum Oil Co., Inc., New York, N. Y., a corporation of New York: U. S. patent 2,520,058, issued Aug. 22, 1950.

In a process for determining the characteristics of a porous material wherein said porous material is impregnated with a plurality of liquid phases one of which phases is a water phase and another of which phases is an oil phase and said water phase and said oil phase are in contact with each other within said porous material, the method of measuring the extent of oil saturation of said porous material which comprises dissolving in said oil prior to impregnation of said porous material di-dodecyl ester, tetrahydro ortho-phthalate of cobalt-60, impregnating said porous material with the resulting oil solution, and thereafter measuring the gamma-ray emission from said porous material as a function of the extent of oil saturation of said porous material. Claims allowed, 11.

12308. Geiger-Müller counter tube. Paul Burg Weisz, Swarthmore, Pa.: U. S. patent 2,519,864, issued Aug. 22, 1950.

A gas mixture for the filling of Geiger-Müller tubes for the purpose of providing such tubes with self-quenching properties with pulse equalization at substantially atmospheric internal gas pressure, consisting of a major and a minor component the former of which comprising at least one of the gases hydrogen, nitrogen, argon, neon, and helium, and the latter of which comprising at least one of the hydrocarbons selected from the group of compounds described by the chemical formulae C_nH_{2n+2} and C_nH_{2n} wherein the carbon number *n* be a number between two and eight inclusively, said hydrocarbon component making up from 0.1 percent to 6 percent, approximately, of the total gas pressure. Claims allowed, 4.

12309. Ionization chamber. Emilio G. Segre, Santa Fe, N. Mex., and Owen Chamberlain, Philadelphia, Pa., assignors to the United States of America as represented by the U. S. Atomic Energy Comm.: U. S. patent 2,521,656, issued Sept. 5, 1950.

An ionization chamber having in combination, a metallic housing sealed from the atmosphere, an hydrogenous material disposed within said housing, said material filling a major portion of the volume therein, an ionizable gas maintained within said housing to fill the volume intermediate said hydrogenous material and said housing, a pair of electrodes mutually spaced within said housing and insulatingly supported from said housing by said hydrogenous material, means preventing the transmission of slow neutrons from a point exteriorly of said chamber to said hydrogenous material comprising protective elements opaque to the transmission of slow neutrons substantially covering said electrodes and the interior of said housing, a substantial portion of said electrodes being exposed to said ionizable gas, and means maintaining said electrodes at a difference of potential. Claims allowed, 4.

12310. Geiger-Müller counter. Morris H. Shamos, New York, N. Y.: U. S. patent 2,522,902, issued Sept. 19, 1950.

A Geiger-Müller counter comprising a cathode, a pair of bushing tubes carried in axial alignment therewith, a plurality of metallic bands deposited on said bushings, selected bands being sealed to said cathode and a selected band being sealed to a grid cap mounted on one of said bushing tubes, a wire assembly carried by said bushings, and means to couple conductors to said grid cap and to said cathode. Claims allowed, 6.

WELL LOGGING

12311. Method and apparatus for producing neutron logs of drill holes. Robert E. Fearon, Jean M. Thayer, and Gilbert Swift, Tulsa, Okla., assignors to Well Surveys, Inc., Tulsa, Okla., a corporation of Delaware: U. S. patent 2,515,500, issued July 18, 1950.

A subsurface neutron-logging instrument that comprises a substantially gamma-ray-free source of neutrons and a detector of gamma radiation utilizing an ionizable medium and spaced from the source of neutrons, substantially all metallic surfaces of said detector that are exposed to the ionizable medium consisting of metals which will not emit heavy ionizing particles when bombarded with neutrons. Claims allowed, 22.

12312. Neutron well logging. Robert E. Fearon, Jean M. Thayer, and Gilbert Swift, Tulsa, Okla., assignors to Well Surveys, Inc., Tulsa, Okla., a corporation of Delaware: U. S. patent 2,515,501, issued July 18, 1950.

A method of making a neutron log of the formations penetrated by a well that comprises determining from known knowledge of the types of formations penetrated by the well a spacing that is of the order of but less than the average range of neutrons in the types of formations penetrated by the well, spacing the neutron source from the gamma-ray detector a distance that is of the order of this average range, and making a neutron log of any sufficiently similar well while maintaining but less than this spaced relationship between the neutron source and detector. Claims allowed, 1.

12313. Neutron well logging. Robert E. Fearon, Jean M. Thayer, and Gilbert Swift, Tulsa, Okla., assignors to Well Survey, Inc., Tulsa, Okla., a corporation of Delaware: U. S. patent 2,515,502, issued July 18, 1950.

Neutron well-logging apparatus which comprises a source of neutrons of the alpha rayer-target type, in which the alpha rayer consists of at least one short half-life member present in a radioactive series and is in secular equilibrium with a parent member of relatively long half-life and all members of the series being substantially gamma-ray free, whereby the alpha-rayer will be maintained substantially free of gamma radiation and maintained at substantially constant alpha-ray-emitting strength for a period of time at least as long as its normal half life, and in which the target material is disposed in neutron-producing relationship with said alpha rayer, means for moving said source of neutrons within a well in proximity to respective formations through which the well extends thereby to bombard said formations with neutrons, a detector associated with said source of neutrons for detecting gamma radiation produced by the action of the neutrons in the respective formations, and means for recording said detected radiation in correlation with well depth. Claims allowed, 4.

12314. Method and apparatus for producing neutron logs of drill holes. Jean M. Thayer, Robert E. Fearon, and Gilbert Swift, Tulsa, Okla., assignors to Well Surveys, Inc., Tulsa, Okla., a corporation of Delaware: U. S. patent 2, 515,534, issued July 18, 1950.

A method of neutron well logging which comprises traversing the formations penetrated by the well with a subsurface instrument containing a gamma-ray-free neutron source and a detector of radiation containing an ionizable medium, maintaining the source and detector spaced from each other in the direction of the axis of the well while traversing the well with the instrument, maintaining carbon disulfide between the neutron source and the formations, bombarding the formations with neutrons passing from the source and through the displacing medium, detecting gamma radiation resulting from neutron processes in the strata substantially uncontaminated with other gamma radiation by subjecting an ionizable medium thereto and measuring the resultant current. Claims allowed, 2.

12315. Method and apparatus for neutron well logging. Jean M. Thayer, Gilbert Swift, and Robert E. Fearon, Tulsa, Okla., assignors to Well Surveys, Inc., Tulsa, Okla., a corporation of Delaware: U. S. patent 2,515,535, issued July 18, 1950.

In a neutron logging detector, containing an ionizable medium, the improvement which consists in surfaces exposed to said ionizable medium constituted of a material which does not emit heavy ionizing particles when bombarded by neutrons. Claims allowed, 12.

12316. Neutron log. Gilbert Swift, Robert E. Fearon, and Jean M. Thayer, Tulsa, Okla., assignors to Well Surveys, Inc., Tulsa, Okla., a corporation of Delaware: U. S. patent 2,515,745, issued July 18, 1950.

A method of neutron logging a drill hole that comprises irradiating the formations penetrated by the drill hole with mixed radiation consisting of neutrons and gamma rays which are emitted by a common source, simultaneously irradiating the formations penetrated by the drill hole with neutron-free gamma radiation of the same intensity and hardness as the gamma radiation emitted by the source of mixed radiation, separately detecting gamma radiation influenced by the mixed radiation and gamma radiation which originated with the neutron-free gamma ray source and was scattered by the formations, subtracting the latter detected radiation from the first detected radiation and recording the result in correlation with depth of the drill hole at which detection occurred. Claims allowed, 9.

12317. Shielding method and apparatus for radioactive borehole logging. Shelley Krasnow, New York, N. Y., assignor to Schlumberger Well Surveying Corp., Houston, Tex., a corporation of Delaware: U. S. patent 2,522,522, issued Sept. 19, 1950.

In an apparatus for measuring radioactivity within a borehole, a measuring system, sensitive to radioactivity, and adapted to be lowered within the borehole, a shield mounted adjacent the said system, so as to be traversed by rays emanating from material within the borehole, the said shield having portions facilitating the entrance of rays originating distant from the said shield, and having other portions restricting the entrance of rays from material close to the said shield. Claims allowed, 17.

12318. Fluid ingress well logging. Daniel Silverman, Tulsa, Okla., assignor to Stanolind Oil and Gas Co., Tulsa, Okla., a corporation of Delaware: U. S. patent 2,517,603, issued Aug. 8, 1950.

A method of determining the fluid-producing characteristics of formations traversed by a well comprising establishing in said well above said formations an interface between salt water and oil, causing said interface to be lowered in said well by introducing oil into said well above said interface, making a log of the amount of said oil introduced into said well as a function of the depth of said interface, subsequently causing well fluid to enter said well from said formations, locating a detector in said well at only elevations corresponding to a point of inflection on said log, isolating sections of said formations which are permeable, and individually sensing a characteristic of said fluid entering said well within said isolated sections. Claims allowed, 2.

12319. Apparatus for determining the permeability of cores. William L. Morris, Bartlesville, Okla., assignor to Phillips Petroleum Co., a corporation of Delaware: U. S. patent 2,521,079, issued Sept. 5, 1950.

A direct reading permeameter comprising, in combination, a flow-viscosity meter including an inverted frusto-conical tube having a float therein, said tube being calibrated in units of permeability, a core holder, a line for establishing a flow of fluid through said meter into said core holder, and a pressure gage communicating with said line. Claims allowed, 2.

TECHNICAL AIDS

12320. Gravity sensitive variable inductance device. Paul F. Shivers, Edina, Minn., assignor to Minneapolis-Honeywell Regulator Co., Minneapolis, Minn., a corporation of Delaware: U. S. patent 2,515,969, issued July 18, 1950.

A gravity-influences control means comprising in combination, a base adapted to be mounted such as to be subject to inclinations from a normal position about a pair of axes normal to one another and lying in the same plane, a plurality of U-shaped core members secured to said base and arranged in diametrically opposed pairs, said pairs of core members being disposed normal to one another and normal to an axis about which said base is adapted to tilt with each core member spaced equidistantly from a common point, an inductance coil mounted on one leg of each of said core members, pivot means secured to said base at said common point, float means including a magnetic element adapted to pivot on said pivot means and disposed to tilt toward and away from said plurality of core members, and casing means enclosing said float means and said core members secured to said base and containing a liquid which buoys said float means into engagement with said pivot means. Claims allowed, 8.

12321. Vibratory assembly for galvanometers. George R. Morrow, Tulsa, Okla., assignor to Century Geophysical Corp., a corporation of Delaware: U. S. patent 2,519,591, issued Aug. 22, 1950.

A vibratory assembly for galvanometers, comprising, a coil, a pair of suspension elements attachable to opposite ends of the coil, generally U-shaped connector members connecting the ends of said coil to said suspension elements, the ends of said coil being supported between the arms of the respective connector members, and a mirror mounted between the arms of one of said connector members and symmetrically arranged therein with respect to the longitudinal axis of said assembly. Claims allowed, 7.

12322. Galvanometer. Marvin E. Morrow, Tulsa, Okla., assignor to Century Geophysical Corp., a corporation of Delaware: U. S. patent 2,519,689, issued Aug. 22, 1950.

A galvanometer, comprising, a cylindrical barrel, a vibratory element mounted therein, anchoring members connected to opposite ends of said vibratory element for anchoring same to opposite ends of said barrel, one of said anchoring members having a tubular extension enclosing a portion of said vibratory element, and a liquid damping medium contained wholly within said extension. Claims allowed, 9.

12323. Vibration insensitive galvanometer. Henri-Georges Doll, Houston, Tex., assignor to Schlumberger Well Surveying Corp., Houston, Tex., a corporation of Delaware: U. S. patent 2,523,866, issued Sept. 26, 1950.

A galvanometer comprising at least two movable elements having substantially identical dynamic characteristics rotatively mounted on substantially parallel axes adjacent to each other, means for connecting only one of said moving element assemblies to a source of electrical energy, a source-free electrical circuit connected to the other of said movable elements, and mirrors carried by and rotatable with said moving elements for reflecting a beam of light from one mirror to the other and from the latter to a surface, whereby the deflection of the beam of light reflected from said other mirror to the surface will be proportional to electrical energy from said source and independent of spurious externally caused accelerations about axes parallel to the axes of said movable elements. Claims allowed, 5.

12324. Time interval recorder. George W. Barnes, Jr., Clifton Heights, Pa., assignor, by mesne assignments, to Minneapolis-Honeywell Regulator Co., Minneapolis, Minn., a corporation of Delaware: U. S. patent 2,519,537, issued Aug. 22, 1950.

In a recording instrument having a chart upon which a record is to be made and an inked ribbon to make a record on the chart, the combination of, a printing plate, the inked ribbon extending around said printing plate, supply and take-up rolls for said ribbon located adjacent one end of said printing plate, spring means to bias normally said take-up roll in a direction to wind said ribbon thereon and to maintain said ribbon taut, a ratchet on said supply roll, an oscillating plate, a pin on said plate to engage a tooth of said ratchet to prevent said supply roll from rotating, means to bias normally said plate in a position for said pin to engage a ratchet tooth, and cam means engaging with said plate operable upon movement thereof to shift said plate to a position in which said pin is out of engagement with the teeth of said ratchet. Claims allowed, 4.

12325. Electrical instrument. Theodore J. Smulski, Gary, Ind., assignor to Productive Inventions, Inc., a corporation of Indiana: U. S. patent 2,520,897, issued Aug. 29, 1950.

An electrical instrument having a bimetallic member for actuating an indicator, said member having a first portion thereof provided with an electric heating element adapted to be energized in accordance with the condition to be indicated, a second portion operatively connected to said first portion for effecting compensation for distortion of the first portion caused by variations of ambient temperature, and a third portion operatively connected to said first portion to supplement the action to be produced by said heated portion, and a pointer actuated by said member, said third portion being operatively connected to said pointer and arranged to increase in response to ambient temperature rise, the extent of movement of the pointer produced by said first portion in response to a given rise of temperature of the first portion above the ambient temperature thereby to compensate for the increase in heat loss of said heated portion at higher ambient temperatures. Claims allowed, 16.

12326. Electrical instrument. Theodore J. Smulski, Gary, Ind., assignor to Productive Inventions, Inc., a corporation of Indiana: U. S. patent 2,520,898, issued Aug. 29, 1950.

An electrical instrument having heat responsive means for actuating an indicator, said means having a first portion provided with an electric heating element adapted to be energized in accordance with the condition to be indicated, a second heat responsive portion operatively connected with said first portion for effecting compensation for movement of said first portion caused by variations of ambient temperature, and a third heat responsive portion operatively connected with said second portion to supplement the action to be produced by said heated portion, and said third portion being arranged to increase in response to ambient temperature rise, the extent of movement of the indicator produced by the heat responsive portions referred to in response to a given rise of temperature above the ambient temperature thereby to compensate for the increase in heat loss of said heat responsive means at higher ambient temperatures. Claims allowed, 10.

12327. Electrical instrument. Theodore J. Smulski, Gary, Ind., assignor to Productive Inventions, Inc., a corporation of Indiana: U. S. patent 2,520,899, issued Aug. 29, 1950.

An electrical instrument having a bimetallic member for actuating an indicator provided with a connecting part, said member having a first portion provided with an electric heating element adapted to be energized in accordance with the condition to be indicated, a connecting part provided on said first portion, a second portion operatively connected with the first portion for effecting compensation for fluctuation of the first portion caused by variations of ambient temperature, and additional bimetallic means provided with a connecting part, said connecting parts on said member and on said additional bimetallic means being directly connected to the connecting part of said indicator, and one of said parts being arranged to increase in response to ambient temperature rise, the extent of movement of the indicator produced by said first portion in response to a given rise of temperature of the first portion above the ambient temperature thereby to compensate for the increase in heat loss of said heated portion at higher ambient temperatures. Claims allowed, 11.

12328. Locating device. Franklin Offner, Chicago, Ill.: U. S. patent 2,517,702, issued Aug. 8, 1950.

In combination, an infrared radiation sensitive element producing electrical current variations in response to variations in incident radiation, means for cyclically varying the radiation on said element, current translating means connected to said element, switching means synchronous with said radiation varying means connected to output of said translating means, current sensitive means connected to said switching means, and means for adjusting the phase shift of said current translating means to compensate for phase shift in said sensitive element. Claims allowed, 4.

12329. Permeability meter. Harry W. Dietert, Ralph E. Steinmueller, and Carl M. King, Detroit, Mich., assignors, by direct and mesne assignments to Harry W. Dietert Co., Detroit, Mich., a corporation of Michigan: U. S. patent 2,516,188, issued July 25, 1950.

A permeability meter comprising a holder for a specimen of predetermined dimensions, a gas chamber in free communication with one end of said specimen, a member movable in a downward direction for displacing gas from said chamber and through the specimen, electrically operated timing mechanism including an electric circuit having a normally open switch and a normally closed switch therein, a vertically movable element of predetermined weight supported by the gas displacement member for movement downward therewith but free therefrom, a yieldably supported member in the path of said element adapted to be depressed by the weight thereof, to close said normally open switch, a second member yieldably supported with greater resistance in the path of said first yieldably supported member for arresting movement thereof and said element, and a second element movable with the gas displacement member initially spaced from said first element and adapted to contact therewith in the further downward movement of said displaced member to further depress said yieldably supported members and to thereby open said normally closed switch. Claims allowed, 7.

12330. Apparatus for determination of moisture content. Britta Franzén-Lutz and Joseph Peter Lutz, Appelviken, Sweden, assignors to Telefonaktiebolaget L M Ericsson, Stockholm, Sweden, a company of Sweden: U. S. patent 2,520,394, issued Aug. 29, 1950.

Apparatus for determination of the moisture content of a sample of at least partly hygroscopic substance reduced to small particles or granules by measurement of the electrical resistance of said sample, comprising a tubular measuring member for containing said sample, two electrodes for the measurement of said resistance, said electrodes being electrically insulated from each other and consisting of a material having good heat conducting properties and high heat capacity, at least one of said electrodes being constituted by a plunger projecting into one end of said tubular member, means for pressing at least one of said electrodes against said sample with a pressure of such a value that the electrical resistance is independent of the fineness of grain and the distribution of the hygroscopic layers, means for heating at least one of said electrodes, and thermostatic means for controlling said heating means so as to maintain said electrode at a constant temperature with relation to the ambient temperature. Claims allowed, 2.

12331. Geophysical prospecting system. James E. Hawkins, Tulsa, Okla., assignor to Seismograph Service Corp., Tulsa, Okla., a corporation of Delaware: U. S. patent 2,513,314, issued July 4, 1950.

In a system of geophysical prospecting, recording apparatus including means for driving a movable record element, prospecting apparatus including means for activating said recording apparatus to produce a record on said record element representative of a characteristic of the earth's subsurface structure, radio position-finding apparatus, and means responsive to operation of said position finding apparatus for governing said recording apparatus to produce a record on said record element of the geographic position at which said first-named record is produced on said record element. Claims allowed, 5.

12332. Radio position determining system. James E. Hawkins, Tulsa, Okla., assignor to Seismograph Service Corp., Tulsa, Okla., a corporation of Delaware: U. S. patent 2,513,315, issued July 4, 1950.

In a position determining system, spaced transmitters for radiating modulated carrier waves, means at a receiving point responsive to the carrier components of said waves for providing one indication representative of the position of said receiving point relative to at least one of said transmitting points, and means at said receiving point responsive to the modulation components of said waves for providing a second indication representative of the position of said receiving point relative to at least one of said transmitting points. Claims allowed, 52.

12333. Radio Survey system. James E. Hawkins, Tulsa, Okla., assignor to Seismograph Service Corp., Tulsa, Okla., a corporation of Delaware: U. S. patent 2,513,316, issued July 4, 1950.

In a position determining system, three spaced transmitters for radiating continuous waves of different frequencies, means in part responsive to the radiated wave from one of said transmitters for developing a first signal representative of the difference frequency between the waves radiated by said one transmitter and a second of said transmitters and in part responsive to the wave radiated from the third of said transmitters for producing a second signal representative of the difference frequency between the waves radiated by said second and third transmitters, and means for modulating said signals upon a common carrier wave for space radiation. Claims allowed, 26.

12334. Radio position determining system. James E. Hawkins and Robert S. Finn, Tulsa, Okla., assignors to Seismographs Service Corp., Tulsa, Okla., a corporation of Delaware: U. S. patent 2,513,317, issued July 4, 1950.

In a position determining system having a receiving point, a pair of spaced transmitters for radiating position signals, means for alternately modulating the signals radiated by said transmitters with reference signals, and receiving and translating apparatus at said receiving point jointly responsive to said position indicating and reference signals for producing two indications respectively representative of the position of said receiving point relative to different ones of said transmitters.

A wave signal transmission system comprising a first transmitter including means for radiating a signal at one frequency, means for pulsing said signal, a second transmitter for continuously radiating a second signal at a different frequency, and a reference signal transmitter including means for receiving and heterodyning said signals to produce beat frequency signal pulses and means responsive to said beat frequency signal pulses for radiating corresponding reference signal pulses. Claims allowed, 36.

12335. Radio position finding system. James E. Hawkins and Beverly W. Koeppel, Tulsa, Okla., assignors to Seismograph Service Corp., Tulsa, Okla., a corporation of Delaware: U. S. patent 2,513,318, issued July 4, 1950.

Wave signal receiving apparatus for translating received space radiated waves into position indications, comprising a receiver operative to receive a first pair of space radiated waves and to heterodyne said waves to produce a first heterodyne signal having a frequency related to the difference frequency between said waves, said receiver being alternately operative to receive and reproduce a first reference signal having a frequency representative of the difference frequency between a second pair of radiated waves and modulated upon one of said first pair of radiated waves, a second receiver operative to receive and heterodyne said second pair of radiated waves to produce a second heterodyne signal having a frequency equaling the frequency of said first reference signal, said second receiver being alternately operative to receive and reproduce a second reference signal having a frequency representative of the difference frequency between said first pair of waves and modulated upon one of said second pair of waves, phase measuring means excited by said signals in pairs and operative to measure the phase relationship between said first heterodyne and second reference signals and between said second heterodyne and first reference signals to provide two indications of the position of said receiving system relative to two displaced sources of said waves, and signal responsive-signal level control means for maintaining substantial amplitude equality between the signals exciting said phase measuring means. Claims allowed, 14.

12336. Geophysical prospecting system. James E. Hawkins, Tulsa, Okla., assignor to Seismograph Service Corp., Tulsa, Okla., a corporation of Delaware: U. S. patent 2,513,319, issued July 4, 1950.

In a system of geophysical prospecting, recording apparatus including means for driving a movable record element, prospecting apparatus including means for activating said recording apparatus to produce a record on said record element representative of a characteristic of the earth's subsurface structure, radio elevation finding apparatus, and means responsive to operation of said elevation finding apparatus for governing said recording apparatus to produce a record on said record element of the earth's elevation at the location at which said first-named record is produced on said record element. Claims allowed, 7.

12337. Radio position determining system. James E. Hawkins, Tulsa, Okla., assignor to Seismograph Service Corp., Tulsa, Okla., a corporation of Delaware: U. S. patent 2,513,320, issued July 4, 1950.

A system for in part utilizing the modulated carrier waves radiated from a plurality of geographically spaced broadcast transmitters to determine the position and elevation of a receiving point, comprising a fixed station, a mobile station separated from said fixed station and located at said receiving point, receiving means at each of said stations for separating the carrier wave components of said waves from the modulation components thereof, mixing means at each of said stations for heterodyning in pairs the carrier wave components of said waves to develop at least two position signals at each station, a pair of transmitters at said fixed station for radiating elevation signals of different frequencies and for transmitting the position signals developed at said fixed station to said mobile station, means at said fixed station for heterodyning said elevation signals to develop an elevation reference signal and for transmitting said elevation reference signal to said mobile station, additional receiving means at said mobile station for receiving and separating the position and elevation signals radiated from the transmitters at said fixed station, phase-measuring means at said mobile station for measuring the phase relationship between each position signals developed at said mobile station and the corresponding position signal developed by said additional receiving means, thereby to produce indications identifying the position of said receiving point relative to said broadcast transmitters, receiving means at said mobile station for reproducing said elevation reference signal, mixing means at said mobile station for heterodyning the elevation signals reproduced by said additional receiving means to produce a second elevation reference signal, and phase-measuring means at said mobile station for measuring the phase relationship between said elevation reference signals to provide an indication of the elevation of said receiving point relative to the elevation of at least one of the transmitters at said fixed station. Claims allowed, 31.

12338. Radio location system. James E. Hawkins, Tulsa, Okla., assignor to Seismograph Service Corp., Tulsa, Okla., a corporation of Delaware: U. S. patent 2,513,321, issued July 4, 1950.

A combined pulse-transit time and phase-comparison system of position determination, comprising transmitting apparatus for concurrently producing pulsed signals for phase and pulse transit time comparison, and receiving apparatus remote from at least a portion of said transmitting apparatus and including phase-measuring means and pulse transit time comparison means both responsive to said signals for producing separate indications representative of the position of said receiving apparatus relative to at least one of the sources of said signals. Claims allowed, 44.

12339. Radio-location system. James E. Hawkins, Tulsa, Okla., assignor to Seismograph Service Corp., Tulsa, Okla., a corporation of Delaware: U. S. patent 2,513,322, issued July 4, 1950.

A pulse-transit time radio-location system, comprising a first transmitter for radiating a first signal of one frequency, a second transmitter for producing a pulsed signal of different frequency, a third transmitter for radiating a carrier signal at a third frequency, heterodyning means for heterodyning said first and pulsed signals to produce a pulsed reference signal having a frequency related to the beat frequency between said first and pulsed signals, modulating means for modulating said pulsed reference signal upon the carrier signal radiated by said third transmitter, and receiving apparatus including pulse transit time comparison means responsive to the pulsed signals produced by said second and third transmitters for producing an indication representative of the relative positions of said receiving station and at least one of said transmitters. Claims allowed, 19.

INDEX

Abstract
Alfvén, Hannes 12153
Aliverti, Giuseppina 12182
Andrée, H 12287
Antsyferov, M. S 12175

Bardeen, Thomas 12291
Barnes, G. W., Jr 12324
Bartels, Julius 12158, 12184
Bateman, J. D 12279
Beamer, W. H 12305
Benfield, A. E 12149
Benson, A. C 12155
Bernholtz, Ben 12269
Berson, I. S 12260
Bethune, P. de 12234
Birch, Francis 12217
Blankenship, E. B 12232
Boaga, Giovanni 12128
Bödvarsson, Gunnar 12146
Bolo, Robert 12141, 12147
Bowen, W. A 12156
Brannock, W. W 12218
Brekhovskikh, L. M 12167, 12168
Breyer, Friedrich 12240
Brockman, F. G 12303
Bruet, E 12220
Bucher, W. H 12221, 12222
Buchheim, Wilhelm 12259, 12272
Bukhnikashvili, A. N 12203
Bullard, E. C 12150, 12151
Bureau des Recherches géologiques et géophysiques 12276
Bush, R. E 12286

Cagniard, Louis 12152
Cantos Figuerola, José 12264
Carome, E. F 12258
Carreño, Alfonso de la O 12145
Castet, J 12161
Castro, Honorato de 12142
Ceng, Youngtsen 12148
Chamberlain, Owen 12309
Chang, C. Y 12148
Clark, A. R 12269
Closs, Hans 12245
Coulomb, Jean 12178, 12200
Crumrine, K. C 12273
Csongor, Eve 12213
Cunietti, Mariano 12131

Dahlberg, R. S., Jr 12297
da Silva Gamerio, José 12248
de Andrade, Adalberto 12248, 12249
de Sitter, L. U 12246
Dietert, H. W 12329

Abstract
Di Filippo, Domenico 12189
Dix, C. H 12169
Dodson, R. W 12305
Doll, H. G 12285, 12323
Dos Reis, Arrude 12248
Dupouy, G 12162

Eblé, Louis 12143
Eckhardt, E. A 12236
Emery, K. O 12229
Enenstein, B. S 12270
Ewing, Maurice 12170, 12187, 12188

Fearon, R. E 12295, 12311, 12312, 12313, 12314, 12315, 12316
Finn, R. S 12334
Fontseré, Eduardo 12194, 12195
Franzén-Lutz, Britta 12330
Fritsch, Volker 12267
Frolov, A. I 12137, 12138

Gassmann, Fritz 12164
Geophysical Directory 12237
Gilchrist, Lachlan 12269
Gilmour, Andrew 12255
Gimeno Riutort, Antonio 12196
Giorgi, Maurizio 12180
Gloden, Albert 12132
Goguel, Jean 12147, 12277
Goldin, A. S 12280
Gougenheim, André 12141
Green, A. E 12166
Grenet, Gaston 12160
Grushinskii, N. P 12136, 12193
Guimarães, Djalma 12210
Gutenberg, Beno 12190

Hamilton, G. R 12187
Hardtwig, Erwin 12201, 12235
Hawkins, J. E 12331–12339
Hée, Arlette 12216
Hersey, J. B 12187
Hodge, M. W 12154
Holmes, Arthur 12212
Honnell, P. M 12289
Howe, H. H 12157
Hughes, D. S 12231, 12232
Hurley, P. M 12252
Hvoroslev, M. J 12239

Irons, H. R 12251

Jarovoy, Michel 12216
Jeffreys, Harold 12209
Jones, H. J 12231

Abstract
Jones, P. H. 12275
Jones, W. R. 12238
Joset, Alain 12179

Kanai, Kiyoshi 12172, 12176
Kanne, W. R. 12300
Kazanskii, I. A. 12127, 12129
Kebuladze, V. V. 12203
King, C. M. 12329
King, P. B. 12226
Kilchling, Karl 12133, 12134, 12135
Kleiber, Joseph 12216
Koeppel, B. W. 12335
Korff, S. A. 12206, 12207
Krasnow, Shelly 12317
Krey, Theodore 12261
Ku, K. G. 12148

Lehmann, Inge 12183
Lorenz, Hans 12257, 12263
Lozano Calvo, Luis 12130
Lundberg, H. T. F. 12298
Lutz, J. P. 12330
Lynch, J. J. 12202

Maclen, R. L. 12280
Maher, J. C. 12275
Maple, E. 12156
Marcelli, L. 12189
Martin, Jean 12179
Martins da Silva, João 12248
Matschinski, Mathias 12223
Menis, S. 12181
Mihailovič, Jelenko 12191
Mims, R. L. 12232
Modriniak, N. 12250
Molard, Pierre 12178
Moore, A. F. 12155
Morelli, Carlo 12126, 12181
Morris, W. L. 12319
Morrow, G. R. 12321
Morrow, M. E. 12322
Morton, G. A. 12304
Müller-Deile, G. 12265
Müller, Max 12274

Nathan, Hans 12219
Nedeljkovič, R. L. 12192
Neil, H. G. 12301
Nesbitt, R. H. 12256
Neufeld, Jacob 12302
Niggli, Ernst 12164

Offner, Franklin 12328
Oliphant, C. W. 12177
Oñate Espinosa, Roberto 12244

Parker, G. G. 12198
Paul, Bernt 12268
Perlow, G. J. 12299
Pettersson, Hans 12186

Abstract
Poisson, Charles 12159
Poldini, E. 12205
Press, Frank 12170, 12187, 12188
Pringle, R. W. 12278

Quarles, Milton, Jr. 12262

Ramachandra Rao, M. B. 12241
Ramspeck, Adolf 12266
Reich, Hermann 12185
Reichertz, P. P. 12307
Roberts, A. 12285
Roche, Alexandre 12163
Rodgers, John 12227
Rodriguez Aguilar, Manuel 12243
Rohrer, E. R. 12280
Rohrer, R. H. 12208
Rothé, Jean 12165
Rothersberger, Hans 12164
Runcorn, S. K. 12155

Scherbatskoy, S. A. 12296
Schleusener, Alfred 12140
Schmitz, H. P. 12204
Schonstedt, E. O. 12251
Schroeder, C. A. 12299
Schulze, G. A. 12266
Schumann, H. 12288
Segre, E. G. 12309
Seigel, H. O. 12233
Selenyi, P. 12290
Sezawa, Katsutada 12172, 12176
Shamos, M. H. 12310
Shipman, J. D., Jr. 12299
Shivers, P. F. 12320
Silverman, Daniel 12318
Singer, S. F. 12156
Skeels, D. C. 12144
Smulski, T. J. 12325, 12326, 12327
Solaini, Luigi 12182
Stead, F. W. 12281, 12282
Steenland, N. C. 12188
Steinmueller, R. E. 12329
Stringfield, V. T. 12198
Sundquist, K. J. 12199
Sweet, R. C. 12292
Swift, Gilbert 12311–12316
Szalay, A. 12213

Thayer, J. M. 12311, 12316
Thompson, J. B. 12252
Thomson, W. T. 12171
Tikhonov, A. N. 12271
Tiratsoo, E. N. 12214, 12215

U. S. Geological Survey 12253, 12254
Uzelač, Miroslava 12193

Valle, P. E. 12173, 12174
Vening Meinesz, F. A. 12224
Vladimirov, A. T. 12230

Abstract
Wadia, D. N. 12242
Weaver, Paul 12228
Weber, E. K. 12164
Weisz, P. B. 12308
Weng, W. P. 12247
Werner, P. W. 12199
White, D. E. 12218
White, W. C. 12211
Williams, David 12238
Wilson, J. T. 12225
Wilson, V. C. 12306
Worzel, J. L. 12187, 12188
Wulf, O. R. 12154
Wyckoff, R. D. 12293

Yagoda, Herman 12211
Ylanan, C. W. 12197

Zen'kovich, V. P. 12230
Zerna, W. 12166
Ziloff, Wladmir 12283
Zuschlag, Theodore 12294, 12298